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de W2NSD/1

never say die

Vegas

A letter from the Sahara Hotel explained that I could come if I wanted to, but that under no circumstances was there to be any controversial discussion. This kind of substantiated my suspicion that this was not a convention at all, but a thinly disguised excuse for hams to come on out and enjoy girls and gambling. I'd rather buy a new rig.

Sunspots

Now that the present cycle is well on its way upward the experts are watching it carefully, trying to estimate just how high it may actually go. It has already surpassed the prediction made by George Jacobs W3ASK who thought it might peak out at 60-70 and now looks as if it will top off in the 140-150 range. What does all this mean for us? Well, the bands will be hot . . . ten will be wide open a lot now, twenty will frequently be staying open all night . . . conditions are definitely looking up.

Pot shots

Huntoon has been pegging off shots at me in QST lately. In the August issue he reported an IARU censuring movement against an unnamed amateur radio magazine, strongly implying that it was 73. I wrote directly to the party who instituted the censuring movement and have a letter from him stating that this was against another amateur magazine, and not 73. Tsk, tsk . . . yellow journalism.

Huntoon is still trying to sweep unpleasant facts under the QST carpet. He appears quite upset in the December Leaky Lines and calls some poor amateur who wrote in "anti-League." John, I don't think that any of us are really anti-League. There are a number of us, a growing number, who are disappointed

in the way the League is running things, but is this a reason to lose your temper and call names?

John, a large number of us are seriously worried about the future of amateur radio and think that something concrete should be done to get more world support for our hobby. We want to know that the League realizes this situation and that it is doing something positive to influence the outcome. Yet we hear of

little being done.

Now, about the 14,000 ARRL members lost last year. First of all I would like to say that I feel responsible for anything that I write and publish . . . I also assume responsibility for anything that I say. But I do not feel that I should be held responsible for something that someone else says I said. In this particular case I was not quoted at all correctly. However, lest anyone think I am trying to weasel out on something, let's just put aside all those pretty little figures that you've trotted out to confuse the unwary . . . and shame on you for doing that, John . . . was that really honest?

The question has been raised about how many members the ARRL lost in 1965. ARRL members, if they want to invest an interesting 75¢, can send for the 1965 Annual Reports. John realizes that very few amateurs do send for this document and thus writes freely. John cannot plead ignorance of the actual figures for they appear in his own personal report to the Directors. In paragraph 5 of his report we find that 18.4% of the ARRL members in the U.S. and possessions did not renew their membership in 1965. In paragraph 4 we find that there are 78,180 full members and 8,753 associate members as of the end of 1965, a total of 86,753 members (subscribers). 18.4% of that is 15,962 subscribers lost in 1965.

Now the bulk of those lost subscribers were replaced by new subscribers so that the *net* drop in overall membership of the League was only 1,214. This all comes from John's report, so let's see if he has anything but a very red face to show on the subject now.

DX thoughts

A letter from an SM complained about the lack of courtesy of the U.S. stations when they are after a rare DX station. I've heard this complaint for a lot of years now and I was rather surprised when I got on from KC4AF a few years back and found everyone to be just as cooperative as I could ask. I had virtually no problems with bad manners from

(Continued on page 112)

Editor's Ramblings

Paul Franson WA1CCH

VHF frequency pressure

Businesses in this country badly need additional VHF frequencies for their two-way communication. Many of the channels allotted to them are hopelessly overcrowded. Two-way users in heavily populated areas often have long waits before their channels are free enough to pass even short messages. Yet other frequencies lie almost unused in the same areas because they are assigned by service rather than location. Agricultural channels are little used in metropolitan areas while more urban channels are jammed.

These inequities should be straightened out, of course. But that won't solve the whole problem. Two-way users simply must have more channels. The question of where these frequencies will come from is a vital one to hams. A few years ago, it seemed inevitable that at least part would come from the VHF ham bands. We could hardly complain with much justification in view of the small use these wide bands get. But things are looking up for hams now. We may not have to lose any VHF frequencies after all. Our possible saviour is an unlikely-seeming one.

Let's go back a few years to see what happened.

In the forties, when it was apparent that television was going to be feasible commercially, frequencies had to be allotted to it. The decision was made to assign channels in what is now our VHF TV band. Time has shown that this was a bad decision and that it would have been better to have allotted higher frequencies, but then no one was able to convince officials how popular TV would be, and how much interference the VHF TV channels (particularly the low band ones) would suffer during periods of favorable propagation.

So the channels were assigned and stations started broadcasting. It wasn't long before it was obvious that there simply weren't enough channels for all the cities that wanted TV, and all the interests that wanted to own TV stations, so additional frequencies were added in the present UHF TV band. Plenty of frequencies were made available so that there were 70 UHF channels and 12 VHF. Some UHF stations went on the air, but most suffered serious financial problems and many closed down. They had a number of strikes against them. First, most TV receivers couldn't receive UHF. UHF was an optional accessory, and many people wouldn't pay extra for it. Others who already had TV's wouldn't spend the money for a UHF converter and antenna, so watched the VHF channels by default even if there was a UHF station near them.

Also, UHF has a more limited range than VHF for the same power and equivalent antennas. Early UHF front ends were very noisy and unsatisfactory unless supplied with a strong signal. Thus UHF stations had a smaller audience than VHF and while the VHF stations prospered, UHF stations did poorly in most areas—especially if they had VHF competition.

In a belated realization of the mistake in not putting TV on UHF in the first place, the FCC made some attempts to help the UHF broadcasters. One plan was to have all TV areas either VHF or UHF without any mixing. This was obviously an unsatisfactory scheme in well-populated regions where other stations might be receivable, and you can imagine what the reaction of the typical VHF broadcaster to this idea was. This plan was squelched. Part of the impetus for the squelching came from Congress since many Congressmen and other government officials have interests in broadcasting stations.

Finally the FCC and others decided that a better answer was to insure that all TV sets could receive UHF. This would reduce the competitive advantage of VHF somewhat, especially since improved broadcasting and receiving techniques (high power transmitters,

(Continued on page 108)

Integrated Circuit Crystal Calibrator

This calibrator generates 10 and 100 kHz markers. It costs less than \$13.

The crystal calibrator ranks with the SWR bridge and code practice oscillator in coverage in the various ham magazines. The names have ranged from the obvious "crystal calibrator" to the less obvious "transistor secondary frequency standard" and "multical". The type of circuitry involved has likewise ranged from simple tube circuits to more complex solid state digital circuits.

The IC crystal calibrator could be considered one of the more complex of the above listed calibrators, providing 100 kHz and 10 kHz outputs. Because of the use of integrated circuits instead of transistors, it is, however, one of the simplest and cheapest. The one described was built for under \$13.

NOR gates and flip-flops

QST, July 1965.

For those who don't have W1CFW's excellent article on the Micro-Ultimatic,³ the oper-

¹ Grigg, "A Transistor Secondary Frequency Standard",

³Davisson, "The Multical", 73 Magazine, October 1966. ³Pickering, "The Micro-Ultimatic", 73 Magazine, June ation of the two basic logic elements are reviewed.

The truth table shows all possible combinations of inputs (A and B) and the resulting output (Q) for the NOR gate. The Fairchild $\mu L914$ contains two of these gates in one package.

A	В	Q	
L	L	H	
\mathbf{H}	L	L	
L	\mathbf{H}	L	H = high $L = low$
H	H	L	L = low

Notice that a high output occurs only if botl inputs are LOW.

Any other combination produces a LOW output.

The truth table for the flip-flop is as follows

S	C	Q
\overline{H}	L	H
L	\mathbf{H}	L
L	L	Reverse
H	H	No change

Fig. 1. Block diagram of K1DCK's crystal calibrator. Output is both 100 kHz and 10 kHz and total cost is under \$13.

G-3

The states S and C are considered before the trigger has occurred, and Q is the condition of the flip-flop after the trigger occurs with a given S-C combination. The flip-flop has two states. It is SET when Q is LOW. It is cleared when Q is HIGH. Another input, called PRE-SET, can be used to make Q LOW regardless of its state and without a trigger.

Binary number system

For the following discussion, forget that 1 and 1 is 2 and we can clear up the last bit of theory needed to understand the operation of this calibrator. To simplify large digital computers, a number system was evolved that contains only two digits (0 and 1) rather than ten digits (0 thru 9).

To see how this system works, think of the odometer on your car and imagine each wheel on this odometer using only two numbers-0 and 1. As the car sat on the showroom floor, the mileage might have read 0000. When you drove it off, registered the first mile (and lost \$1000 resale value), it would read 0001. Okay so far. But when you register the second mile and the right wheel on the odometer advances one more place, a zero appears again since that is the only other number! This second mile clears the first wheel back to zero and advances the second wheel to one. So now the odometer registers 0010. This represents the decimal number two in the binary system. The third mile would read 0011. The fourth mile turns the first wheel to zero, which turns the second wheel to zero, which advances the third wheel to one, and so on. With only four wheels on the odometer, we could register up to 1111 which would be fifteen miles. The sixteenth mile would register as 0000, so we would need a fifth wheel for this number (10000). A list of all the binary numbers from zero thru ten is shown below.

0	0000	6	0110
1	0001	7	0111
2	0010	8	1000
3	0011	9	1001
4	0100	10	1010
5	0101		

These binary numbers are called binary-coded decimal or simply BCD.

Pulse generator

The output of the pulse generator is a 100 kHz pulse. The high to low transition will be used to trigger the counter. The idea of using the μ L914 as a crystal-controlled pulse generator is from a Fairchild application note. With

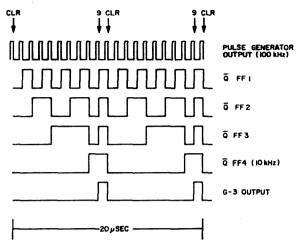


Fig. 2. Waveforms of various points in the BCD counter. Peak-to-peak voltages will vary from one to three volts.

the values shown in Fig. 1, the circuit works well with any of the surplus crystals in HC13/U holders advertised in "73". Another crystal in an HC6 case (also surplus) worked with different values of C1 and C3. Juggle them around; you can't hurt anything.

For those of you on a tight budget, stop here. You have just constructed the cheapest and most reliable 100 kHz calibrator anywhere! However, for those of you who aren't afraid of the XYL, we'll add on the counter/divider.

BCD counter

Sometimes called a divider, this circuit has the ability to count to nine and reset to zero on the tenth count. It is called a divider, because for every ten pulses at its input, it produces one pulse at the output—division by ten. Naturally, for every 100,000 pulses at the input, the output will be 10,000 pulses: the 10 kHz marker. Any inaccuracy in the 100 kHz pulse is divided by ten also, but the percentage of error remains the same.

Looking back at the odometer example, each wheel had two states—ZERO and ONE. A flip-flop also has two states—SET and CLEAR. So flip-flops can easily be substituted for wheels, making a counter which counts in exactly the same way the odometer did. But

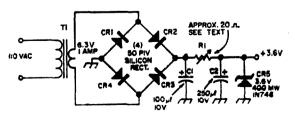
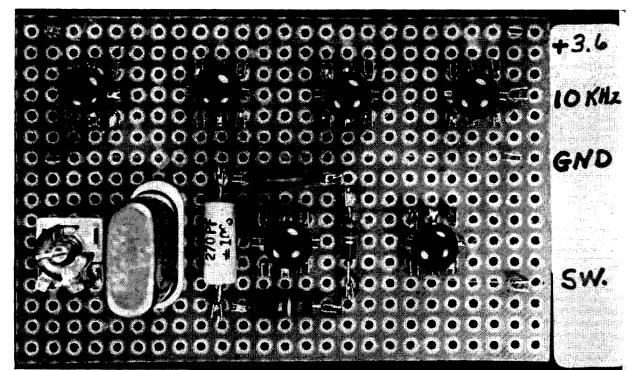


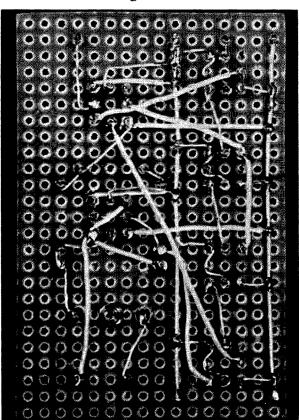
Fig. 3. W1CFW's power supply. Also see Fig. 8 on page 14 in the December 73.



Photos by Harvey Benoit, Haverhill, Mass.

Top, left to right—FF1, FF2, FF3, FF4. Bottom, G1/G2, G3/G4.

this counter counts to fifteen! The counter is fooled into thinking it has reached fifteen



View of the underside of the board, showing wiring. The right bus is +3.6 V. The bus near the center is ground.

when, actually, it has only reached nine. The action of G-3 does this.

In the binary system, nine is 1001 and fifteen is 1111. The states of the flip-flop when it reaches nine are as follows:

FF	Q
FF1	H
FF2	L
FF3	L
FF4	Н

To make the counter think it has reached fifteen, G-3 will go H and preset FF2 and FF3, changing Q to H. This is done by applying Q output of FF1 and FF4, both of which are LOW at this time, to the input of G-3. FF1 and FF4 are SET only when the counter has reached nine.

Power supply

The calibrator draws 80 mA at 3 volts and 95 mA at 3.6 volts. A power supply similar to WICFW's may be used and is reprinted in Fig. 3. Adjust R1 for 20 mA zener current,⁴ under load. The separate power supply is recommended since tube-type receivers will not have suitable voltages available. The power supply won't be very big; if you have a tube-type receiver, you're probably not that finicky about miniaturization anyway.

Ashe, "Zener Diodes", 73 Magazine, October 1966.

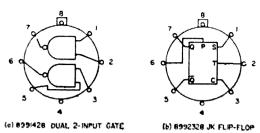


Fig. 4. Bottom view of Fairchild gate and flip-flop IC's. The right side of the gates should be curved.

Construction

The details used in this project are clear enough in the photographs. Flea clips are mounted on a piece of Vectorboard about 2½ x 3½ inches. No attempt at miniaturization was made, so you may want to try. The crystal socket and trimmer were mounted, then all the wiring underneath was done. The large bus across the middle is the ground bus; and the one at the top is the +3.6 voltage. Wire pin 4 of every can to ground and pin 8 to the +3.6 voltage. Pin connections are shown in Fig. 1. Wiring is point-to-point; and teffoncovered wire was used for crossovers. The IC's were then mounted using normal precautions with semiconductors. On some of the earlier epoxy units, pin 8 was identified by a red line; it is identified by a flat spot on present units. The Fairchild UX8991428X is used for G-1/G-2 and G-3/G-4. Fairchild UX8992328X's are used for FF-1 thru FF-4.

Operation

The output of the calibrator may be connected thru a small capacitor, or "gimmick", to the antenna terminal of your receiver. As many receivers have provisions for a plug-in calibrator, the capacitor may already be in. My NCX-3 uses a 6-inch piece of coax. One end of the center conductor is connected to the output of the calibrator and the shield on the other end is connected to the antenna terminal. The small capacitance between the inner and outer conductors makes the small coupling capacitor.

There are two ways to turn the calibrator off when not in use. One is to put a switch in the primary of the power supply transformer. Don't switch the +3.6 voltage. Operating the power supply without a load may damage the zener. Another way is to make use of G-4. Fig. 5 shows how this may be done. With pin 5 always LOW and pin 3 open, the output of G-4 is HIGH. This HIGH has no effect on the operation of the 100 kHz oscillator. If this point goes LOW, then pin 6 will be clamped LOW and the oscillator stops. This

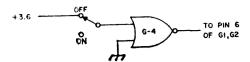


Fig. 5. Gated on/off switch.

point will be LOW if pin 3 is HIGH, which would be the case if the switch were in the OFF position.

Harmonics were quite useable up to 30 MHz. It's possible they may be heard on six meters, but no receiver for this frequency was available. In the event the harmonics are not useable on six, this should present no problem, since the calibrator could be hooked into the antenna terminal of the HF receiver. The harmonics would certainly be heard on the frequency used for the converter *if*. Of course, this scheme would work for any of the VHF bands.

This calibrator points out several of the advantages of integrated circuits. It is small in size and cost, but big in performance. Since it "flew" right off the drawing board, and is easily duplicated, the ease of circuit design is apparent.

. . . K1DCK

Where to Buy Fairchild Semiconductors

Fairchild Semiconductors are very popular with many ham experimenters and engineers, as can be seen from the many articles in 73 that specify them. But none of the large, well-known national mail order distributors that go after the consumer trade seem to carry Fairchild. Nevertheless, Fairchild has an extensive network of excellent and very large industrial distributors. Hams who don't work in the industry may not be familiar with them, but these dealers carry very large stocks and are usually very pleasant to deal with even though their sales to individual hams are a very, very small part of their business. You can get a list of Fairchild distributors from Richard Molay WA6KGS at Fairchild Semiconductor, 313 Fairchild Drive, Mountain View, California 94041.

One Fairchild distributor that has indicated that they're happy to handle mail orders from individuals is Cramer Electronics, 320 Needham Street, Newton, Mass. 02164, and 60 Connolly Parkway, Hamden, Conn. A call or letter to them will give you current prices on any Fairchild semiconductor.

Some Notes on VHF Transistor Converters

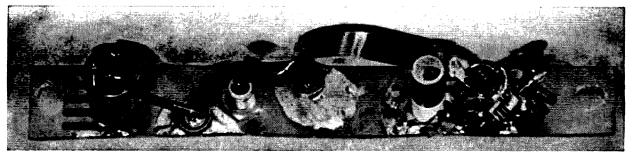
Frank discusses some problems with the popular TIXM05 transistors, adds some notes on newer transistors, and describes an improved 220 MHz converter in this article.

The transistor converters, described in the June 1966 issue of 73, using the low cost TIXM05 transistors have brought a great many inquiries about the source for these little gems. Personally, I'd like to know myself as after the first purchase from a Texas Instrument (TI) distributor of a few TIXM05's, my next request was back ordered for six months and still no delivery. Finally I received several dozen TIM10 transistors which were supposed to be an improved type in the same price range. The breakage problem with the plastic cased transistors seems to be solved, and the characteristics were much more uniform. The "forward gain" characteristics were much better also but all this added up to some changes in circuit values, and even in type of circuits, particularly at 432 MHz. The "X" in the TI transistors apparently stands for experi-

Fig. 1. Forward gain control for one or two rf stages. R should be 510 for an 8-volt supply, 620 for 9 V, and 1000 for 10 V.

mental type which may not be produced in large numbers. The writer will shun those types in future magazine articles, having been "burned" once is enough.

The TIM10 transistors that I've tested so far in the 50, 144, 220 and 432 MHz. converters do not have quite as good a noise figure as a few selected TIXM05's, particularly at 432 MHz. However, at approximately a half dollar cost, they are excellent values, being quite superior to the three dollar types such as the 2N2398's. The forward gain characteristics and higher collector current requirements seem to have been met by the circuit values shown in Fig. 1. The 5000 ohm "pot" permits adjustment of gain for difference antennas, power supply voltages over a limited range, and cross-modulation problems in some receiving locations. The collector series resistors for dc voltage drop should be around 500 ohms for the TIM10 rf stages with a dc supply of 8 to 9 volts. For 10 volt supply a 1000 ohm collector resistor will give greater gain control and 1500 to 2000 ohms could be used for even better results with a 12 or 13 volt supply. The emitter resistor in all cases should be around 500 to 600 ohms. The base bias resistors, two fixed and one variable, should be fairly satisfactory for 8 to 12 volt supplies. The TIM10 transistors will work satisfactorily on any of the VHF bands without neutralization if the base input impedance is kept to 50 ohms or less and a variable gain control is available to keep them below the oscillating points. Too high a collector load impedance will also cause oscillation problems. At 50 and 144 MHz, sometimes a 3900 or 5100 ohm ¼ watt resistor can be wired across the collector tuned circuit to keep the load impedance within reason. A great deal depends upon shielding between stages and the effectivenes of rf bypass capacitors. Sometimes parallel capacitors of 500 or 1000 pF can be conected from emitter to nearby copper plated ground points with short



432 MHz preamplifier using the new Motorola EL229 in a grounded emitter unneutralized circuit. Note that the EL229 is an NPN transistor, while the TIM10 is PNP.

leads to cure a stubborn rf oscillation.

Most of the new transistors such as the Motorola EL 229 and the Texas Instrument TIM10 types are much more stable at 432 MHz when used in grounded emitter circuits as compared to the older grounded base designs. The grounded base circuits are inherently regenerative and require heavily loaded circuits and critical base bias adjustments. This regenerative effect was necessary with older types of transistors to get good results at 432 MHz. The new types apparently have smaller capacitances and usually will not oscillate at 432 MHz when used in grounded emitter circuits with no neutralization. Grounded emitter circuits can be neutralized at lower frequencies where higher input and output impedances will mean more gain and possibly lower noise figures. Grounded base circuits are real "blankety-blank" things to neutralize, as theory would indicate.

The new experimental Motorola EL229 plastic cased transistor will probably cost more than the TIM10 but is a real gem on 432 MHz. The noise figure checked within 1 to 2 dB of that obtained with a parametric amplifier which had a 1600+ MHz pump oscillator. The apparent noise figures were compared by using a weak signal generator connected to each rf amplifier thru high quality 50 ohm 10 dB pads. A similar 6 dB pad was connected in the output of each of the two rf amplifiers into a reasonably stable 432 MHz converter with its rf stage. A comparison of microvolts input in the two cases gives a pretty good idea of the actual noise figure of the rf stage under test. The transistor pre-amplifier shown in the photograph on a long narrow copper plated strip and in Fig. 2 uses an EL 229 in a grounded emitter unneutralized circuit. Its perormance indicated that transistor development is catching up with diode parametric amplifiers. The latter are highly regenerative and costly as compared to the simple transistor rf amplifier shown in the photograph and in Fig. 2. The EL 229 is a NPN transistor so can not be compared easily with a PNP TIM10,

etc. Separate rf amplifiers designed for the TIM10 seemed to show from 1 to 2 dB poorer noise figure than the EL 229. The EL 229, with about 1200 MHz f_T , was better than the very expensive 2N3783 PNP transistor, which in turn was better than the TIM10 units tested here so far.

Let me emphasize the fact that I think the EL 229 is an experimental transistor and may not be available yet at Motorola transistor outlets. I've heard a rumor that it will be about a dollar in price. The experimental rf pre-amplifier in the photograph was built on a scrap piece of copper plated plastic board %" wide and 6" long to fit into a small space available near the regular 432 mc converter. The transistor has three wire leads in line, with emitter in the center to give some added isolation between the base and collector circuits. The EL 229 transistor was soldered directly into the circuit using a cooling clamp between the transistor case and the point of soldering to the wire lead. The base input impedance is approximately 50 ohms at 432 for best noise figure, so was connected to the coax input jack thru a 300 pF coupling capacitor to isolate the base bias circuit from the grounded antenna. A small four turn coil of #20 wire about 5/16" long and %" diameter tends to tune the input capacity of the transistor to 432 MHz. It also tends to short out if band

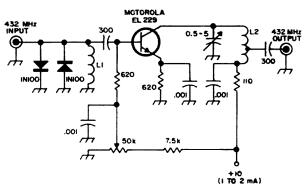
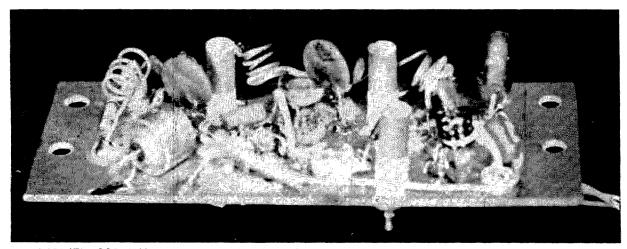


Fig. 2. Low noise 432 MHz preamplifier. L1 is 4 turns #20, 5/16" long x 1/3" diameter. L2 is 2" of a 3/16" wide copper strap bent into a U. Tap up about 1/2".



W6AJF's 220 MHz converter using TIM10's. It's built on a 2" x 5" piece of copper-clad board. See the article on a 220 converter in the June issue for more information.

feedthru signals. The collector circuit consists of a 2 inch long by 3/16" wide piece of copper strip soldered to the tuning capacitor and transistor at one end and to a 1000 pF feedthru bypass capacitor at the other end. These little A-B solder-in feedthru capacitors are very good up thru 432 MHz but are hard to find since they are a manufacturer's item. The slightly larger 500 pF button feedthru capacitors which are used in surplus gear are not bad at 432 MHz. A small 300 pF disc capacitor was connected in parallel to the 1000 pF feedthru capacitor to add a little rf "cooling" to the emitter. The small 5000 ohm pot was adjusted for best signal-to-noise re-

ception which occurred at a collector current of between 1 and 2 milliamperes. The output coax jack used capacitance coupling on a tap about ½ inch from the by-pass capacitor in the collector circuit. Link coupling is another possibility.

Connection of this pre-amplifier as well as a couple of other rf grounded emitter 432 MHz units to a diode noise generator, with or without a 6 dB pad, resulted in a curious noise figure effect. The collector circuit always had to be tuned to a lower frequency (more tuning capacity) for best noise figure measurement in the output of a 14 MHz if receiver. Two types of diode noise generators were used with

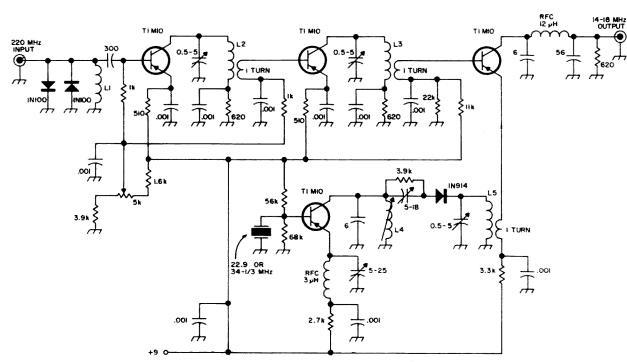


Fig. 3. 220 MHz converter built on a 2" x 5" copper plated board. L1, L2, L3 and L5 are **each** 4 turns #18 wire $\frac{1}{4}$ " in diameter. L1 is $\frac{1}{2}$ " long and the other three are $\frac{3}{8}$ " long. L4 is 11 turns #24 enamelled on a $\frac{1}{4}$ " form with a brass slug. The winding is $\frac{1}{4}$ " long.

similar results. This effect was not noticed in grounded base 432 MHz amplifiers, nor in equivalent grounded grid tube amplifiers. Possibly a 432 MHz neutralized transistor amplifier would not have this problem. The final result was to always use a very weak signal from an antenna or from a signal generator (thru a pad) to align the 432 MHz circuits. This method permits extremely weak signal reception which is the desired result.

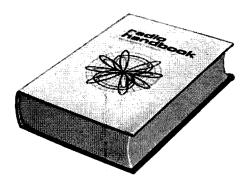
The 220 MHz converter shown in Fig. 3 and in the other photograph was built on a 5 by 2 inch piece of copper plated board. It uses the new TIM10 transistors in grounded emitter circuits without neutralization. The small 1000 pF feedthru capacitors connected to each rf stage emitter were shunted by rather large 820 pF di bypass capacitors. These were connected from emitters to ground across the transistor sockets and act as small shields between tuned circuits as well as aiding in bypassing the emitters to ground. The two rf stages and mixer circuits were run along one side of the board, and the crystal oscillator and diode frequency multiplier on the other side, so the final multiplier coil is near the mixer socket. A low Q broad-band pi network covering 14 to 19 MHz connects the mixer collector to a coax line output to an if receiver which in turn is used to tune the 14 to 19 mc. band. Several of these 5 inch long converter boards were mounted in a 13 x 5 x 3 inch chassis to complete the shielding. All forward gain controls were mounted on a small panel at one end of this chassis. Also included was a small 10 volt zener regulated supply made from a 6.3 volt ac transformer and a diode voltage doubler (full wave) with three 1000 µF 15 volt filter capacitors. The power supply and if coax outputs are switched from different converters by means of a small wafer

The apparent noise figure ranged from 3 to 4 dB in the 220 MHz band subject to errors in the noise generator calibration. This simple converter is somewhat similar to the one described in the June 1966 issue of 73 magazine. Like many letters I've received over the past few decades, "it's just like the one you described in the magazine except it's smaller, uses different parts, and different transistors (or tubes)"—except in this case it works, hi.

Just received word from a TI distributor here in California, that there will be six weeks delay on delivery of more TIM10 transistors. By the time this article is printed, there should be lots of these transistors available and let's hope some of the real hot Motorola EL 229 units on the market also.

. . . W6AJF

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A KW With The New Amperex 6KG6

The purpose of this article will be to see what can be done with the new 6KG6. The actual amplifier design is the result of trial and error. It is not supposed to be an example of the latest and most sophisticated technique.

Under the "New Products" heading in one of the recent magazines we spied a brief write up on the Amperex 6KG6. The 34 watts plate dissipation and obvious high voltage capabilities took our eye. So we wrote the Amperex company for spec, then got four 6KG6's for experimental purposes. We are more than pleased with them.

It is assumed that the ham who starts out to home brew a kilowatt is not embarking on his first construction project. So whoever decides to build up some 6KG6's will do it his way with what he can salvage from his junk box. This is what we did.

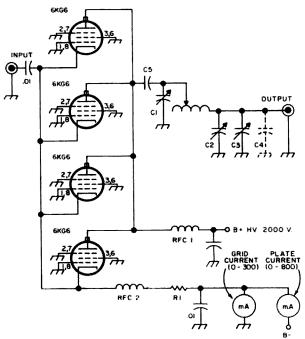
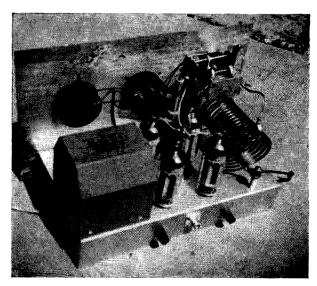


Fig. 1. Schematic of the 6KG6 linear.

We decided to go the grounded grid route by tying all of the grids (control, screen, and suppressor) together and grounding same. As a first try we decided to use an MB 150 National all band tuner in the plate circuit. Don't do it, chum! We wound up on 75 meters tuned about where 40 ought to be and 40 was clear out of the tuning range. It seems that when you tie three grids together and ground them, using four tubes in parallel, you have a plate to ground capacitance on the order of 100 pF. This puts a high frequency limitation on any amplifier and calls for some unusual tank circuit design.

We wound up with the amplifier as shown as per the schematic in Fig. 1. The tank is designed to use minimum C₁ on the higher frequencies due to the plate to ground capacitance being in parallel. This means a turn-byturn experiment. In our case we simply used a battery clip to find the proper tap and then marked the coil. The tank coil should be 20 turns of \%6 inch copper tubing or heavy ground bus copper wire about 2½ inches in diameter. Or-you design your own. The taps could be located by trial and error and then wired into a rotary switch if you like front panel control for all bands. We didn't have a switch. And-what's that double-spaced midget capacitor on top of the tank capacitor? You guessed it—we ran out of copper before we got 20 turns and couldn't quite get on 75 meters and had to outboard a little extra. Some ex-

Bob is the department chairman and an associate professor of electronics at the Oregon Technical Institute. He has a BS in EE and an MA from Washington State University. Many of Bob's 30 articles have appeared in 73.



Back view of the 6KG6 linear good for about a kW input on 80 through 15.

planation is probably in order about the assorted junk we used. C1, the tank capacitor, was liberated from an old command transmitter. The spacing is such that you can't unload the amplifier or it will are over. We always make initial loading adjustments on reduced voltage anyhoo. C₂ and C₃ are 300 pF variables we had on hand. This is still insufficient loading capacitance for the lower frequencies so we outboarded a fixed C4 through a co-ax "T" from the output connector. On 75 meters this amounted to a .001 uF mica and on 40 meters a .0005 µF mica. Strangely enough we found that parasitic suppressor chokes are not necessary with the 6KG6's in this amplifier. Previous experience with 6JB6's led me to put them in. Later we took them out and the amplifier is perfectly stable. RFC1 has to be a good rf choke capable of at least a half amp or maybe an amp. The one used has been on hand a long time and I believe it was made by Johnson. Any good choke that will operate all bands should be ok. This is not a new problem for those who have ever built a shunt fed plate circuit. RFC2 can be a garden variety but must also carry total plate current.

We used an Ohmite choke which measured about 8 microhenries. More would be better. R₁ is a 100 ohm 10 watt wire-wound resistor which is ok for SSB but probably would be better if it were 20 watts. Also if the high voltage is to be left on all of the time 150 or 200 ohms might be better. Our HV is tied to a relay energized by the exciter. We like to have a grid meter but it is not entirely necessary. With the HV turned off you can easily pin a 300 mA meter. Plate meter is in series with the whole stage and the power supply on the B- side.

In its final form the linear performs very well on all bands 80 thru 15. In each case the tank is tapped for as low a value of C₁ as possible. On 15 meters only two turns of the coil are used and the L/C ratio leaves something to be desired; in fact the roving clip lead gets hot. So the output is somewhat reduced. With a Swan 350 as driver the amplifier can be driven to well over 1 kW dc input on all bands. With a 180 or 200 watt PEP rig on 75, 40, or 20 you could get close to 1 kW. We operated at all voltages between 1000 and 2000 volts. At 2000 it is very easy to drive the millameter to 600 mA on speech peaks with the Swan. (We did this into a dummy load, not on the air) There is no flattening. The resting current at 2000 volts is close to 100 mA which makes the plates a cherry red. The plate supply turns off while we are receiving. Total rated dissipation is 132 watts; so we are crowding it in true ham style. Maybe a little greater R₁ would be a good idea. Just how high you can run the HV we don't know but 2000 volts seems like enough.

No doubt the 6KG6 will operate at comparable power as a grounded cathode amplifier and require much less drive. This almost always leads to neutralizing problems and with a pi network this always gets a bit sticky. We have plenty of drive for the grounded grid and it's so much simpler and so much more stable. Anyhoo it looks like the 6KG6 has a promising future.

... W7CSD

Drilling Glass

There are several schemes which are used for drilling holes in glass, but most of them are difficult to manage in the home workshop. A simple solution to this problem requires only a dab of wood putty, a teaspoon of kerosene and an old triangular file. First of all, the file is ground down to a point on the end; then it is placed in the drill motor chuck. Place the dab of putty on the glass where the hole is to

be drilled. Fill the crater with kerosene and start drilling with the triangular file bit; drill slowly and keep the bowl in the putty filled with kerosene. To keep the kerosene from splattering, it may be necessary to run the drill motor at a reduced speed. At any rate, this method of drilling glass is much faster and more convenient than any method I have tried yet.

. . . Iim Fisk W1DTY

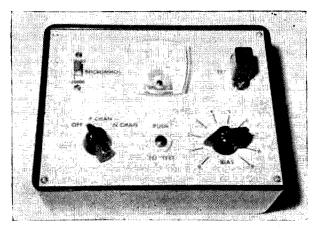
Field Effect Transistor Transconductance Tester

FET's are becoming more and more popular with hams. Here's a simple tester for them.

With the recent advances made in the manufacture of field effect transistors (FET's), the resultant price reductions and their extended usage by industry, greater and greater quantities of FET's have been dumped on the surplus market. Many of these surplus FET's are perfectly good, but some are defective; this isn't usually the fault of the dealer, he just doesn't have an easy way to check them.

Unfortunately, you can't check out an FET with an ohmmeter like you can a conventional junction transistor; some other method must be used. The most obvious approach is to use a transconductance tester similar to that used in testing vacuum tubes. However, since the FET requires no filament power and a relatively low value of B+, the entire test unit may be made quite compact and portable.

You will remember from your school days that the transconductance of a vacuum tube was the ratio of the change in plate current to the change in grid voltage with the plate voltage held constant. For the field effect transistor, the definition is almost the same; just change the name of the respective elec-



The FET transconductance tester. The pushto-test switch is a Grayhill model 35-1; the transistor test socket a Pomona TS-187.

trodes and you have it: FET transconductance is the ratio of the change in drain current to the change in gate voltage with the drain voltage held constant. In practice all you have to do is apply the proper bias voltages to the FET, apply a small measured amount of gate drive voltage and measure the amount of resultant ac drain current. Then the transconductance in mhos¹ may be calculated from the following formula:

$$g_m = \frac{I_d}{E_g}$$

 $\begin{array}{rcl} \mbox{Where:} & \mbox{g_m} & = & \mbox{Transconductance in mhos} \\ & \mbox{I_d} & = & \mbox{Change in drain current} \\ & \mbox{E_g} & = & \mbox{Change in gate voltage} \end{array}$

When the drain and gate measurements are given respectively in microamperes and volts, the transductance is given in millionths of a mho or micromhos, the conventional term.

The FET transconductance tester described here combines the essential necessities with some operating conveniences that make it more versatile for all around FET tests. Basically, a small amount of 1000 Hz voltage is applied to the gate of the FET; the resultant 1000 Hz drain current is rectified by the full wave diode bridge and measured on the meter. The bridge circuit is capacitively coupled to the drain of the FET so the dc supply component will not affect the meter reading. Likewise, a large choke is included in dc supply lead to prevent the 1000 Hz signal from being bypassed to ground through the power supply.

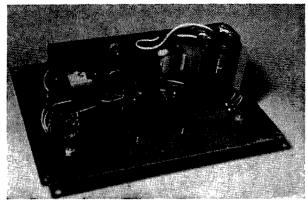
A potentiometer is connected in the gate bias circuit so that the gate bias may be varied from zero to nine volts. This is very helpful in determining the effect of various bias levels and in measuring the gate-cutoff or

¹ The new term for mho is siemens. Unlike hertz, siemens is not widely used yet.

pinchoff voltage of the device. Since the polarity of the dc supply voltage may be conveniently switched from the front panel, this unit will accommodate either P- or N-channel FET's. In addition, two ranges of transconductance, 2000 and 20,000 µmhos, are provided by placing appropriate shunts across the meter.

The entire transconductance tester is built on a 415/16 by 61/16 inch aluminum panel laid out as shown in Fig. 2. After the unit is completed, this panel is mounted in a standard bakelite instrument box. All of the active circuitry, including the 1 kHz audio oscillator, is laid out on a piece of perforated Vero board 1% inches wide by 4% inches long. This board is mounted to the front panel with an aluminum angle bracket. No screws are used to hold this bracket to the panel; the battery polarity switch, push to test button and bias poteniometer do the job. There is no crowding of the board. The layout is not at all critical and any convenient arrangement is suitable. The two batteries are mounted on one side of the unit in an aluminum bracket which is epoxied to the Vero board.

The toughest part of the whole construction lies in the meter shunts. The meter used in the author's tester, a 50 microampere unit from Radio Shack, required two shunts, one for 100 microamperes and one for one milliampere full scale. These currents correspond respectively to 2000 and 20,000 micromhos full scale. The required values were calculated from the standard formula and then made up



Interior of the transconductance tester. The 1000 Hz oscillator is mounted in the upper left hand corner of the Varo board. The batteries are installed in a metal clip on the far right.

from standard carbon composition resistors. In each case a carbon resistor with a resistance value *less* than the desired shunt resistance was chosen. Then a small amount of the resistor was filed away with a rat-tail file until the resistance was raised to the desired value. Initial resistance checks were made with an ohmmeter; final tests were made by comparing the shunted meter to an accurate VOM. Except for the nonlinearities which seem to be inherent in low cost meters, the results have been encouraging.

After the shunt resistors are completed, they should be completely covered by a coat of epoxy cement. Since the protective composition cover is destroyed during the filing, the epoxy coating will prevent the ingress of moisture. Moisture will change the value of

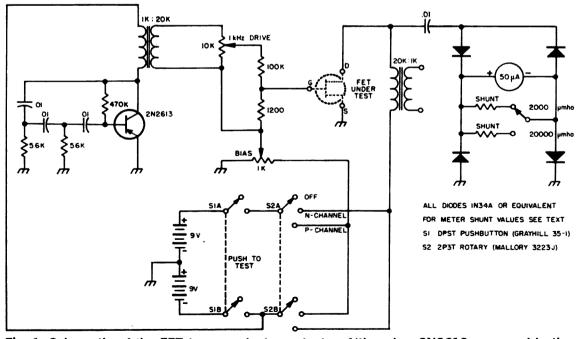
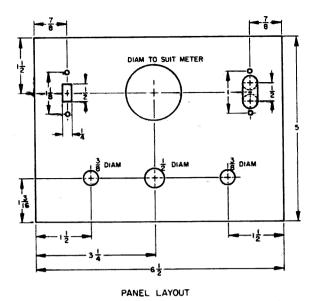


Fig. 1. Schematic of the FET transconductance tester. Although a 2N2613 was used in the 1000 Hz oscillator in the original model of this tester, almost any high gain transistor may be used in this circuit.



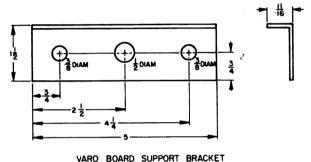


Fig. 2. Panel layout and Varo board mounting bracket.

the shunt resistance and affect the accuracy of the meter.

Although it is not strictly necessary to duplicate the parts used in the author's transconductance tester, it does help in acquiring the necessary components. All of the parts are available from the large mail order houses such as Allied, Lafayette or Newark. This is a help because several of the parts, notably the 2PST pushbutton switch, are not normally available through neighborhood distributors. The 50 microampere meter was chosen because of its modern appearance, availability (locally) and low cost. However, any small instrument with a sensitivity of 50 or 100 microamperes would be suitable. A 100 microampere meter would have the additional advantage of requiring only one shunt (for 20,000 micromhos full scale).

After the tester is completed, there are several adjustments which must be made before plugging in an FET. First of all, connect a set of ear phones across the secondary of the transformer in the output of the audio oscillator. When the push to test button is depressed, a 1000 Hz note should be heard. Switching from P-channel to N-channel should have no effect on the tone. Next, measure the amount

of 1000 Hz signal available on the high end of the drive potentiometer with a VTVM; 8 volts RMS is about right. Now, place the VTVM test probe on the wiper of the driver pot and adjust for 1 volt RMS. This will put 100 millivolts of 1000 Hz drive on the gate of the FET being tested.

Now connect the dc probe of the VTVM to the gate connection on the test socket and adjust the bias potentiometer for 5 volts. Loosen the knob and set it opposite the 5 on the bias scale. If you don't have a VTVM for these initial setups, don't worry about it; a good VOM will work just about as well.

The discerning readers among you have probably figured out that 100 millivolts of drive (0.1 volt) and 100 microamperes of drain current do not add up to 2000 micromhos... You're right, they don't-1000 micromhos is more like it. That is, if all of the 1000 Hz drain current were flowing through the bridge. However, in this circuit, the 1000 Hz drain current divides just about equally between the audio choke in the drain power supply lead and the capacitively coupled meter circuit. So, twice as much drive must be applied to obtain accurate readings. would be circumvented by using a larger value of coupling capacitance. However, when the push to test button is depressed, there is a large surge of current through the capacitor as it charges through the diode bridge. In the original model of this tester, the large voltage spike from the charging of a 0.47 coupling capacitor (since replaced by the 0.01 µF) destroyed a couple of \$13 FET's.

Now you're all set to test those new FET's. Set the P- or N-channel selector switch, put the meter on 20,000 micromhos, and set the bias pot to zero. Push the test button—if the FET is a good one, the meter should swing up scale. If it doesn't, try adjusting the amount of gate bias. If you still don't get a reading, change the setting of the P- and N-channel switch; the device may have been mismarked.

When a good FET is being tested, note that the transconductance varies with the amount of gate bias voltage. Normally, as the bias is increased from zero, the transconductance will increase and then decrease. The point where it starts to decrease after reaching a peak approximates the gate cutoff-voltage or pinchoff voltage. This is directly analogous to the grid-cutoff voltage in a vacuum tube. With knowledge of the cutoff voltage and transconductance curve, it becomes quite easy to optimally bias the device in a circuit. Remember though that these are the characteristics of the FET with a 9 volt drain supply; other supply volt-

ages will change the operating characteristics slightly. However, this does not negate the usefulness of the transconductance tester; on my bench it has proven to be extremely useful in determining bias levels and in sorting out defective FET's.

Afterthoughts

How would you like to measure the transconductance of conventional junction transistors? In some transistor circuit design transconductance is a very useful characteristic. This can be very easily done by the addition of one SPDT switch connected in the gate (base) supply lead as shown in Fig. 3. In the FET position the gate voltage is oppositely polarized from the drain supply voltage. In the junction transistor mode the base supply voltage has the same polarity as the collector supply. Now the transconductance tester will measure the transconductance of PNP devices when in the P-channel position, and NPN devices when in the N-channel configuration.

When running transconductance tests on junction transistors, handle the bias control very carefully. Most transistors will be destroyed if the base to emitter voltage is more than 4 or 5 volts; some with considerably less. Since the emitter of the transistor is grounded in this test circuit, always start the test with the bias pot on zero.

The additional capability afforded by this one switch has the additional advantage of discriminating between FET's and junction transistors. It's quite easy to tell whether that newly acquired FET is really an FET or a mismarked (or misadvertised) junction transistor!

. . . WIDTY

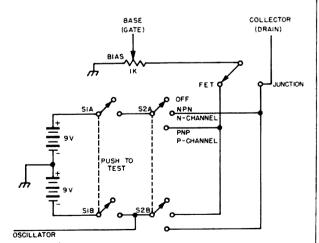


Fig. 3. The addition of a SPDT switch allows the use of this tester with junction transistors. This switch may be mounted on the front panel below the push-to-test switch.

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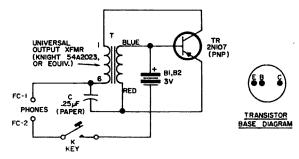
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Climbing the Novice Ladder

Part II: Joe Starts A Home-Brew Project

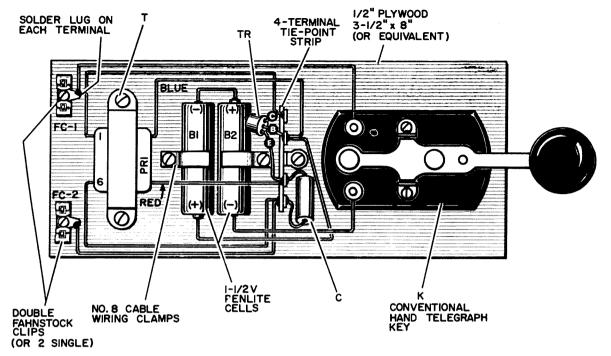
On the Saturday morning following his initial visit with Larry to the ham shack of ol' timer Dwight Mansfield, or 'FN' as he preferred to be labelled, Joe hopped on his Honda and again headed out to the basement shop. Today was the day he was to build a code practice oscillator under FN's guidance, as his initiation into amateur radio 'home-brew' construction. After greeting Joe heartily, FN immediately launched into a bit of preliminary explanation. "I've got everything here in this little tray Joe, all cadged from my junk box, so we're ready to go. While a little piece of gear like this could be mounted in a neat little metal cabinet and marked with decal lettering. it's hardly worth it. A CPO, which is what the hams call a code practice oscillator, is not considered a permanent piece of station equipment. You'll probably use it for only a few months at most and then discard it for its original purpose, saving the parts however to start your own junk box for future projects.



Here's the schematic of the code practice oscillator (CPO) shown in pictorial form above.

So let's mount it 'bread-board' style on a little wooden base. That way you'll find it easy to work on and you can turn out a neat little job in a very short time. I picked up a little piece of scrap board the other evening and gave it a coat of paint to take away the 'raw' look. It's nice and dry now and you can go right to work on it. Your first chore will be to mount the few parts and I've made a rough layout sketch for you to follow. You'll find all the tools you'll need right here on my tool board so go to it; I'll be right outside mowing the lawn if you run into anything that puzzles you; call me when you're through mounting the parts."

Thanking FN, Joe turned to the bench and picking the parts from the salvaged TV dinner tray, identified them one by one from the sketch FN had left him. "Gee," he thought. "that TV tray is a neat idea for keeping the parts right in front of you where you can easily find 'em. We use those TV dinners at home; I'll get Mom to save me the trays." Taking up the transformer which appeared to offer a good starting point, Joe reached for a screw-driver nested with others in an orderly rack on the tool board, positioned and marked the transformer placement on the baseboard in the position shown on the sketch. With a handy prick punch the screw holes were started and with a couple of #6x½" round head wood screws from one of the tray compartments, the transformer was soon mounted. The pen light batteries which would power the CPO, seemed like the next logical items to mount. FN's sketch called for a couple of



Pictorial diagram of the simple code practice oscillator that Judy and Joe built under FN's supervision. It's shown half size.

cable wiring clamps for this and sure enough, there were two in the tray. Another pair of wood screws and presto . . . the batteries were in place.

Joe had just selected the tie-point terminal strip to mount next and was positioning it on the baseboard when the door opened and he was a bit taken aback when not FN, but an attractive young lady of about his own age walked in! She put him at ease at once in the easy familiarity of today's teen-agers; "Hi . . . you must be Joe Blake . . . I'm Judy Mansfield, FN's granddaughter," adding as she wrinkled her pert little nose, "I call him Gramps though. He told me I'd find you here and thought maybe I could give you a hand."

"Well hi" Joe replied, "are you a ham too?"
"No" she said, "not yet. Gramps has been giving me the old needle for some time now to learn the code and join the fun but I couldn't get too much interested in learning by myself . . . it looked like a dreary job. Gramps says you're about to start studying for your ham ticket; maybe we could work together."

"Wow," Joe thought, "she's really neat; this sounds like a break!" Aloud he said, "Sure Judy . . . it'd be a lot more fun learning that way; you wanna help me finish this little oscillator?"

"Why not Joe . . . Gramps has used words like that lots of times . . . maybe now I can find out what they mean!"

Having established a common bond through

a mutual interest (perhaps not entirely electronic!), Joe proceeded to explain what little he had so far accomplished. "Look Judy; here's what we have to do" he continued. "Mount these other pieces on the board like I did with the other two. Why don't you do the tiepoint and the key . . . I'll show you how I did the others." Judy proved pretty adept with the prick punch and screw driver and did her part in short order, prompting Joe to say, "Gee Judy . . . you handle tools like an old hand . . . ever use any before?"

"Lots of times Joe; I've helped Dad with his cabinet-making, putting on little hinges and things like that. Once I spent quite a bit of time right here helping Gramps put a hi-fi kit together . . . it's kinda fun." With that Joe was sure he'd found a kindred spirit; now ham radio really was for him!

All that was now left of the mechanical assembly was mounting the little clips which would serve as binding posts for the phones. These were labelled "Fahnestock clips" on FN's sketch and Joe had them and their accompanying solder lugs mounted in place in short order. "Well, I guess we're ready to wire the thing Judy; I'd better let your Gramps know" and so saying Joe went to the door and called, "All parts mounted FN . . . what next?"

From around the corner of the house FN replied, "All set eh? I'll be with you in a minute." As he came through the door he said, "Well I see you kids got together. I thought you might find it a little more pleasant to work

together as long as you both have an interest in ham radio. You'll find Judy pretty handy with a screw driver and a pair of pliers Joe . . . look out she don't outstrip you in homebrewing."

Laughingly Joe replied, "Yeah; she sure takes hold of a tool like a born mechanic."

Connecting the parts looked to be not too difficult; Joe had done more than a little soldering in his school physics class and in experimental electrical projects at home. Judy had somewhat less experience although FN had shown her the basic principles of soldering and she had made a few connections for him from time to time; both she and Joe were therefore adequately equipped for this little project.

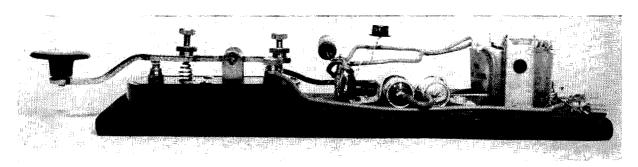
FN handed them another rough sketch which showed the wiring in pictorial form. He then explained, "When you've had a bit of experience in building electronic gear you won't need these wiring 'pictures' to work from. You'll use a 'schematic diagram' which uses symbols to represent the various parts and simple single lines to show the connections. When you're through with this job I'll draw you a schematic circuit on the back of this sketch and you can compare them; all good ham constructors use schematics just like the professionals do. I'm going to give you just one tip before you start wiring. We're using one of the little transistors for the oscillating element here . . . you know about transistors from your pocket radios. We could use a vacuum tube but it would take a more intricate power supply, would cost more, complicate the building and gain . . . nothing! We could even use a common, ordinary buzzer like you probably have at your back door. Either of these would make up into a useable code practice set. We've ignored the tube for reasons I've explained . . . buzzers generally have an unpleasant raspy sound and often change pitch while you're sending; this throws you and upsets your practice. The transistor oscillator is stable, reliable, produces a nice tone and is easy to build but it is susceptible to excess heat. When you solder it's three wires to the tie-point strip, be sure and hold each wire close to where you are going to solder, with the long nose pliers and do the soldering as rapidly as possible but be sure it's a solid connection . . . I'll check it when you're through. Besides holding the wire in place for you, the pliers will serve as what we call a 'heat sink' which will draw the heat to the pliers rather than having it run up the wire to the transistor body. That's it kids, I'll go finish mowing the lawn."

The young people turned back to the bench and while Joe picked up and examined the transistor, Judy suggested, "Joe, why don't we do the transistor *first*; we'll get it out of the way then . . . the rest looks pretty easy."

"OK" Joe replied as he plugged in the soldering iron; "you wanna put on the first wire and I'll do the next?"

"Oh, no Joe . . . you put on the first two while I watch vou . . . that way I'll catch on and then I'll do the last one."

With that, Joe picked up the long nose pliers and carefully made a little hook in one of the tiny wires protruding from the transistor body. He hooked this into terminal lug #1 on the tie-point strip and squeezed the hook closed with the pliers. The quick heating iron was ready now so, with a short length of solder wire and holding the connecting wire close to the terminal with the pliers, Joe completed the termination. Previous experience in soldering had taught him to always apply the heated tip of the iron directly to the terminal; never to the solder. When the terminal itself had absorbed sufficient heat to melt the solder, he carefully placed the end of the solder wire against the terminal at the point where the little wire hooked into it, keeping his iron in place against the back of the terminal until a small amount of solder had liquefied and run down over the face of the terminal, burying the wire hook in the molten solder. He then carefully removed the iron so that the cooling solder was not disturbed. He then repeated the operation using the second wire from the



Side view of the code practice oscillator built by Judy and Joe.

transistor and after cradling the iron in its rest, handed the pliers to Judy. As she had absorbedly followed the process both times that Joe had accomplished it, she then proceeded to repeat his performance in commendable style; both were satisfied that they had the transistor licked. As Joe unplugged the iron to keep from cooking the tip, the door opened and FN appeared with a couple of bottles of Coke and a bowl of potato chips. "Time out for a Coke break, kids; you ready for it?" Both replied in chorus, "You said it!"

FN then produced a thermos of hot coffee from the confines of his shack, poured himself a cup and while giving it a minute to cool a bit, examined the transistor wiring. "Good," was his pronouncement, "you've got nice shiny joints proving that they are soldered with metal, not 'resin' joints held together with the flux from the solder wire. A resin joint won't conduct electricity and your project won't work. A cold solder joint, produced when you don't heat the connection sufficiently to make the solder flow freely, is bound to be a troublemaker too. You can recognize a cold joint as the solder won't be smooth and shiny but will appear dull and grainy. You do have a bit of resin residue on the surface of the solder though. While it does no harm, it makes the joint appear unfinished. You can easily remove this by scraping lightly with the point of a knife blade, followed by wiping it with a cloth dipped in alcohol or shellac thinner. There's some thinner in that upper cabinet . . . rags in the metal waste can under the bench . . . want to clean it up Judy?"

FN rinsed his cup at the laundry tub faucet, the empty Coke bottles were dropped back in the carrier and Judy proceeded to clean the resin residue from the tie-strip terminals. finding it surprisingly easy and quick and resulting in a more workmanlike appearance to the soldered terminals. By then, FN had gone out to clip the hedge after leaving them several scrap lengths of hook-up wire with which to complete the wiring. Removing the insulation from the wire ends, commonly referred to as skinning and preparing the wire for connection by tinning or coating with a thin film of solder, was duck soup for Joe after having accomplished such operations both at school and at home. He soon had Judy cutting the wire lengths he needed, skinning the ends and passing them to him to tin and solder in place. Working together like this the job went fast and in half an hour Joe unplugged the iron and said, "Well, Judy, I think we've got it made . . . it should work now; wanta call your Gramps?"

FN gave the completed project a careful

inspection; almost at once he said, "A nice looking job kids but it'll never work!"

With some trepidation Joe asked, "What's wrong FN?" while Judy shot her Gramps a questioning look.

"Look here Joe, you've left out one all-important wire . . . from the key to the battery!"

A quick look and with a somewhat crestfallen look, Joe acknowledged the point . . . "Don't know how I missed it FN, but I sure enough did; cut me a 4" hunk of wire, will you Judy?" and he plugged the iron back in.

Entering his shack, FN tossed back over his shoulder, "It's the little things Joe that cause big troubles; can't be too careful in checking even the most minor projects."

As Joe completed correcting the omission, FN came from the shack carrying a pair of headphone receivers. Another quick check-over convinced him that the wiring was now complete and connections solidly made. He inserted the tips of the headphone cord into the Fahnestock clips and manipulated the hand key several times. His expression told the story although both kids could faintly hear the pleasing musical tone the oscillator made, even though the phones were tightly fitted over FN's ears. A relieved sigh from Judy and a broad grin from Joe met FN's pronouncement; "Well done, me hearties . . . you've got yourselves a workable code practice oscillator; now all you have to do is to learn to use it and use it p-l-e-n-t-y! Let's talk about that next.'

Swinging a somewhat battered old cot out from a gloomy corner FN said, "My thinkin' couch . . . you can sit here . . . I'll get my chair from the shack." With all comfortably seated, FN stoked his pipe, lit it and, when drawing to his satisfaction, offered some sage advice; "Joe, Judy lives down the road a piece toward town . . . about three miles closer than I do: that puts you two about 4 miles apart. Now if you're going to get in a reasonable amount of code practice together, you're going to have to arrange pretty frequent sessions between vou. No need to come way out here two or three times a week; glad to have you visit anytime but for code practice you'll do better in a more familiar environment. Joe, you've got a motor bike . . . 4 miles is just a hop, skip and jump for you. Why don't you stop at Judy's place today on your way home, meet her Ma and Pa and work out something among you that will get you kids together for an hour or so two or three times a week? The fall term of school won't start for about five more weeks so you should be able to get in some pretty good licks meanwhile."

"Now here's another little pitch," FN continued, "you've got one CPO between you and

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no headphones . . ."

Joe broke in here with, "I've got a pair of phones, FN, I've done a bit of short wave listening from time to time though I never got really excited about it like I am with ham radio. My phones are marked "2000 ohms"... will they do?"

"Splendid" replied FN, "I have this extra pair of phones which I'll loan to Judy. Now maybe you wonder why two pair of phones with only one oscillator and one key. I'll tell you; I've got a little CPO and several keys left over from my adult education classes at the High School a few years ago; I'll also loan Judy the CPO and a key. That way you'll each have practice equipment at home so you can practice sending to yourselves at odd moments between your get-togethers; you'll gain confidence in handling the key and familiarize vourselves with character formation that way. When you get together, have both pair of phones with you; that's why the double Fahnestock clips on the CPO you just built; you can clip two pair of phones into them then. The CPO I'll loan Judy is fixed the same way so equipment-wise, you're all set now. From here on out it's your baby for the next few weeks. Come out here on Saturday mornings when you can and bring one CPO and I'll check your progress; no need to bring the phones . . . we'll use mine from the shack for the test sessions. Joe, you take this little CPO you just built with you and git fer home now; take this little book too; it will give you a bit of dope on proper grip of the key, character formation and the like; swap the book back and forth between you. I've got to run down to your place this afternoon, Judy, to see your Pa and I'll bring my CPO, a pair of phones and a key for you. S-o-o-o, that's for now kids and let's see what you can do with the code in the next few weeks."

Chorusing their profuse thanks, Judy mounted her bike and took off, Joe leisurely trailing behind on his Honda.

Next month: FN checks Judy and Joe on their progress and starts them on their technical studies. . . . W70E

Parts List

		Parts List
2	FC-1, 2	Double Fahnestock clips (or 4 singles)
1	T	Universal output transformer (Knight 54A20323)
2	B-1, B-2	1.5 volt penlite cells
1	Tr	2N107, HEP250, GE2, SK3003 or almost any other low power PNP transistor
1	\mathbf{c}	.25 μF paper capacitor
1	K	Conventional hand telegraph key
1	TS	4-terminal tie-point strip
2	CL-1, 2	#8 cable wiring clamps
1	RR	14" plywood base-board, 314 x 8"

Bill Johnson W6MUR 9372 Hillview Road Anaheim, California 92804 Illustrations by Wayne Pierce K3SUK

Bill is a consulting engineer with a BSEE from the University of California, graduate work in EE and undergraduate work in law. He's been a ham since 1935, and enjoys DXing.

The QRZ Machine

Insula Nuevo° was the beginning of a long string of triumphs for Jules Silvergold III, W2BUKS. There were St. Ginsburg's Rock, Low Tide Shoal, Ebony Sandbar, and several more that he alone could claim. Jules even received the Elby Jaye Award at a special Texas ceremony for removing so many hazards to navigation as his new countries vanished by the push of a button on his departure. Jules was the unquestioned DX champion, but he found this a strangely lonely experience, for once the other HRAs°° realized there could be no top for them, they rediscovered the fun of the game. Jules traveled alone in a polite but aloof fraternity.

But Jules had other troubles too. Grand-father's estate proved not inexhaustible; moth-balled Liberty ships got scarce, and the cost of rock, barges, and even TNT had soared over the years. The IRS had denied him a deduction for the helicopter, too. Jules' father had long since put his well-heeled foot down and for the first time in his life, Jules was face to face with economic reality. A crisis was approaching.

On his flight back from Amuck Islet Jules stopped in at the Fresno DX conference to hear about the latest exploits of each of the 27 professional travelers and their foundations. Jules had been at Fresno once before, back in 1966 when Foundation Fever first started on its epidemic way. He had regarded it then as a sort of prostitution of the amateur service, but after reviewing the annual balance sheets for many years, Jules now thought differently. In his present predicament there just might be something to this, after all.

• • Honor Roll Addicts

^{*} See QST, February, 1965, p. 96

So Jules listened carefully while the 27 speakers paraded to the Fresno rostrum, showed their slides of the native girls and the erections of stubs and towers, and played recordings of the pile-ups. One of the highlights of the meeting was the recording of the time five DXpeditions were all on at the same time and the piles drifted together on 14025. The speakers had to borrow each other's recordings to find out who worked whom.

Clearly, thought Jules, some improvements were called for. With 97,600 active DX men by actual Honor Roll count, there were well over 1000 for every kHz that remained of the 20-meter band after the Canberra Conference in 1968. (The broadcasters had seen the balance sheets too, and had won some major concessions.) And the Fresno speakers had a lot to complain about. Tactics were indeed getting a bit rough, and more efficiency was clearly called for. One speaker even discarded his carefully prepared talk to editorialize and harangue the convention on this very subject.

And then Jules spotted an old Harvard friend, one of the electronics types who had designed the big 14050 computer used for the first Venus trip. Ferrite Manibit was his name, a scholarly looking bright-eyed chap who, though now graying slightly at the temples and balding on top, was still as bright as ever and was well planted now in W6. Jules invited him up to his 18th floor suite after the dinner meeting for a few drinks and a little private talk.

Jules checked the suite for bugs and swore Ferrite to secrecy on what he was about to say. He told Ferrite about his dollar problems and how even the helicopter was now mortgaged to the hilt. Jules then outlined his plan.

"The real problem is that you simply can't work 97,600 guys in less than 40 days, no matter how hard you try," said Jules. "What every one of these 27 chaps has said is that they need more efficiency. Now I've been thinking. How much memory can you put in the size of a portable typewriter now?"

"Oh, about 4 megabits, I guess," Ferrite replied. "We worked up one computer for the Pluto shot that had about that in it. Of course, we have to go fully integrated to be able to do any processing in that space. Why?"

"Well, what I have in mind is a sort of data processor. I can still afford to fill in one or two more shoals but then I'm through. I thought this time I'd like to work the rest of the boys instead of just W2BUKS. It would improve my popularity, I think, and after looking at these Foundation balance sheets I think it could solve my other problems too. What's the going rate on QSO's, anyhow?"

"Oh, some of them have gone for as little as \$10, what with inflation and all. It depends on whether it's a new one," said Ferrite.

"Well that's a good round figure, and we can convert it to Sterling or Rubles or whatever for the boys abroad. Now what I want is for you to put together a little data processor for me with a keyboard on it, so I can type in the call and all the pertinent data on each contributor before I leave. And I want some recognition circuits in there to unscramble the CW out of the pile and check the call against the master file. If he's paid, it sends a standard report-let's say 579 for the minimum or if he goes to \$25 he gets 599-and then automatically logs the contact on tape. While this is going on, I want it to send QRZ and key the other rig. Then for QSL's all I have to do is play the tape back home and they're printed, stamped and addressed. Think you can do it?"

"Jules, I think you've got something there!" Ferrite's mental abacus was flicking through \$15 average, times 97,600, times 2 for the second contact, less trip expense, payoff to





customs and licensing officials, etc. "I don't see any real technical problem here at all, and I'll tell you what I'll do. I'll design it and build it for you for 50% of the trip net. How's that?" he said.

Jules was shocked. "50%!! Are you out of your mind? 25%!"

"Well I don't ordinarily work on a contingent fee at all, but I'll go 35%, and that's it."

"You have a deal," said Jules. "You get it to me in Long Island by June I and I'll do the rest."

"Just be sure you work me too," said Ferrite. So the QRZ machine was built, and worked beyond Jules' wildest expectations. Ferrite had thought up a few more convenient features, like being able to take several calls at once.

He figured to make at least 1000 QSOs per hour.

Meanwhile, Jules dusted off his Harvard class notes and went to work. Full page ads, brochures and application blanks, mass mailings to the HRAs, and all the rest—it was a publicity campaign never seen before. The applications and \$10 bills came pouring in, for contacts to be made with Volcano Spit. Jules called his foundation the SubOceanic Geological and Geographic Institute (SOGGI) and won the coveted IRS tax exemption on the basis of his stated purpose of research on how to stimulate suboceanic eruptions to create temporary islands.

The expedition itself was routine, at least for Jules. His solid-state equipment easily fitted into the helicopter, and of course his contractors and shipping people were old hands now in manufacturing islands. Jules kept everybody posted through regular QST broadcasts taped from his home station in Long Island. His time of arrival was pin-pointed to the second, and everyone synchronized their watches and got off work in plenty of time. The word was out on procedure—the W6's would come first (Ferrite had insisted on this). then the W2's, and then, in deference to Texas, would come the W5's. Propagation was all worked out so there would be no problem with the signals.

The QRZ machine performed admirably. Once or twice Jules had to type in the call when the check stop light came on, but except for that the predicted 1000 QSOs per hour were easily achieved. While Jules relaxed, the QRZ machine did the work, two bands at once with two rigs per band. When some of the free loaders showed up, the machine would reject their calls as unacceptable and come back QRZ. Those it recognized were automatically logged, and the standard reply made. All in all, the Volcano Spit operation was by far the most efficient and successful of any DXpedition ever. Four days after arriving, 91,382 HRAs had their new country, and Jules' Honor Roll lead was reduced by one. Jules packed up and returned to Long Island.

But once again ancient and outmoded laws took over. Profit-motivated competition, pretty well discredited over the years, emerged. The 27 regular foundations convened an emergency meeting of the DXpedition Foundation Association and took corrective action.

So Jules never had to make that second trip and decrease his Honor Roll lead one more. Ferrite Manibit retired in Palm Springs luxury. QRZ Machines, Inc., was doing an island-office business.

. . . W6MUR

A Simple Converter for 70 cm TV

This three-transistor converter furnishes a quick way to receive ham television signals on 440 MHz.

Here is a simple converter for the 430-450 MHz ham TV band. The two rf stages are conventional quarter-wave trough-line circuits. They possess very high Q so the amplifiers are rather narrow—at least for TV. The mixer-cscillator also uses trough-line circuits.

The AF139 transistor (U. S. equivalent is Amperex 2N3399) has a collector capacitance of only 1 pF and a comparatively high collector resistance so it loads the high Q circuits very little. The converter has fairly high resistance to overloading and spurious signals in spite of the high sensitivity of the converter. Each rf stage has a gain of about 10 to 12 dB.

The tap point on the input trough line is set for a 52-ohm antenna. If you want to use a 75-ohm antenna, the tap should be moved a few millimeters up from the grounded side.

Emitter current of the AF139 should be set at about 1.5 mA for lowest noise.

It is advisable to use button mica or other UHF capacitors for coupling and decoupling. Disc ceramics can be used if they are modified slightly. Heat one side of the capacitor to crack off the ceramic and unsolder one lead. Then place the bare, tinned side of the capacitor against a tinned part of the chassis while heating the chassis from the other side. This makes a very good UHF capacitor, though you may break a few capacitors doing it.

The third transistor in the converter is a self-oscillating mixer. It is stable enough for wideband TV.

A voltage variation of 2 volts causes a frequency drift of only 100-125 kHz (a TV signal is about 4.5 MHz wide). Even a rise in ambient temperature from room temperature to 150° F makes the oscillator drift no more than 80 kHz.

The 0.8 pF capacitor between the emitter and collector maintains oscillation. The inductor L5 compensates the capacitive part of the input impedance, and moreover, functions as a low impedance path for the *if* signal and the emitter current. The collector current of the oscillator-mixer is 4.5 mA.

The if signal obtained after the mixing process is filtered out by L6 and the 6 pF capacitor and fed by a link to the input of a TV receiver tuned to channel 2 (54-60 MHz in the U.S.). L6 is damped with a 2.7 k Ω resistor to get sufficient bandwidth.

L6 and L7 are housed in metal shields on top of the chassis. The coaxial connectors were spaced off the chassis a little to prevent their interfering with the quarter wave lines.

You can silver-plate the chassis and lines for the utmost in reception.

Good luck with the construction and reception.

. . . PAØBVO

This article originally appeared in the February 1966 issue of CQ-PA published in the Netherlands. It was translated by Jos. Stierhout PAØVDZ.

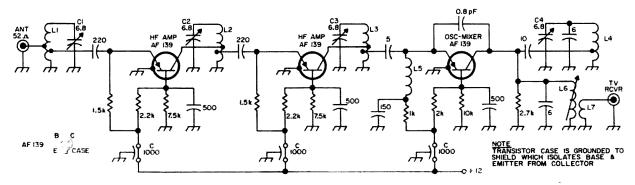
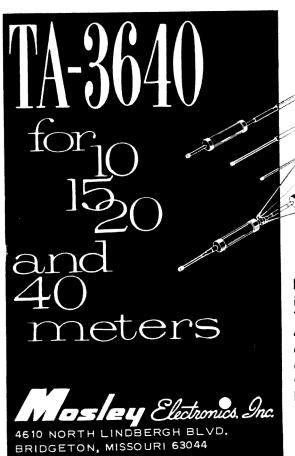
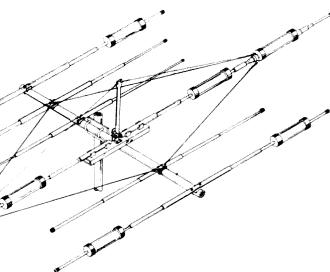


Fig. 1. Schematic of the simple 440 MHz converter for ham TV. L1-L4 are quarter-wave trough lines, 5 mm ($^{1}\!\!/_{4}$ ") in diameter and 68 mm (2-11/16") long. L5 is 3 turns number 18 7 mm (5/16") in diameter. L6 is 7 turns number 18 on a 5/16" form and L7 is 3 turns on it.





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Write for detailed specifications and performance data on the Mosley TA-3640.

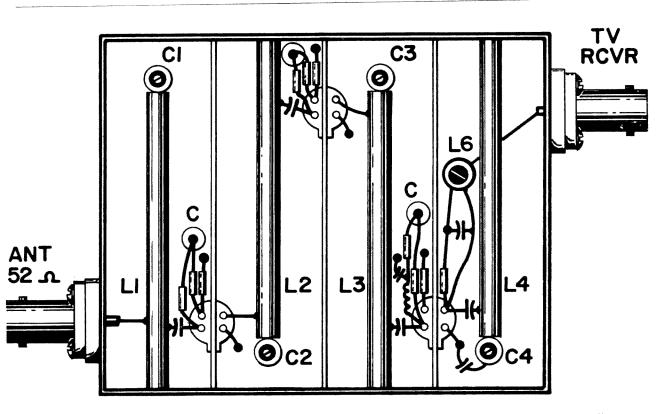


Fig. 2. Full size layout of the ham TV converter. This view is from the underside. The walls of the converter are 30 mm ($1\frac{1}{4}$ inches) high.

Silect Six Meter Converter

This simple and inexpensive six meter converter uses low-cost Texas Instruments plastic-cased Silect transistors. The rf stage is an FET, too.

Have you heard about the new Texas Instruments economy line transistors? TI calls them "Silect" transistors and they give excellent performance at low prices.

I recently attended a transistor seminar sponsored by TI in Dallas. Among the topics and devices discussed were a number of the Silectline transistors, including the TIS34 N-channel VHF epitaxial planar silicon field effect transistor. This transistor, which is a low-cost version of the excellent 2N3823, has been written up before in two 73 articles: "RF Applications of N-Channel FET's" by WA5KLY in the May 73 and "A Low-Cost FET Two Meter Converter" by K6HMO in the October 73. The TIS34 is ideal for VHF mixer and amplifier service. It has a low noise figure and high, high frequency figure of merit. Cross modulation is minimized by its square law transfer characteristics. This transistor is used as the rf amplifier in converter.

The TI409 transistor, which wasn't discussed at the seminar, is an excellent NPN planar silicon transistor for general use. It costs 75¢, not a bad price for a 500 MHz, 200 mW transistor. Both transistors are encased in inexpension.

sive plastic packages. Note that the leads of the TI409 are a bit different from most transistors.

Total power consumption is 2.5 mA at 12 volts.

This converter is similar in many ways to previously-described converters except for the FET rf amplifier. I couldn't find any FET rf circuits when I was starting to build this converter, so I decided to come as close as possible to tube circuits. The gate (grid) resistor was varied from 470 k Ω to 3.9 M Ω ; 1 M Ω seemed best. The source (cathode) and drain (plate) resistors were likewise varied and the best values are shown. You're welcome to try your hand at improving it.

The etched circuit board shown in Figs. 2 and 3 may be used for constructing the converter. The coil forms I used were Cambion SPC-1, 3/16" diameter and 3" high.

It only took two evenings to lay out the circuit and etch the board, and assemble the converter. When I tried it out, I was pleasantly surprised at its excellent performance. It outperforms my other transistor converter and can't seem to be overloaded.

... W5JSN

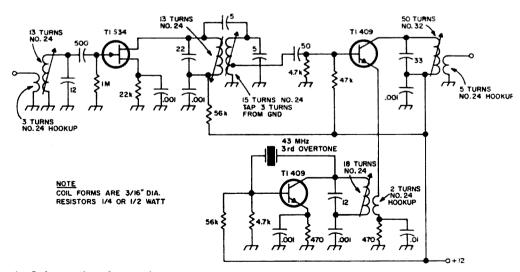


Fig. 1. Schematic of the simple six meter converter with an FET rf amplifier. A suggested etched circuit board is shown in Fig. 2.

Fig. 2. Copper foil side of the etched circuit board for the six meter converter. The board is available for \$1 from the Harris Co., 56 E. Main Street, Torrington, Conn.

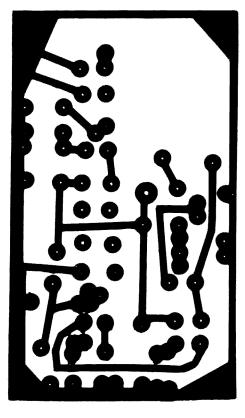
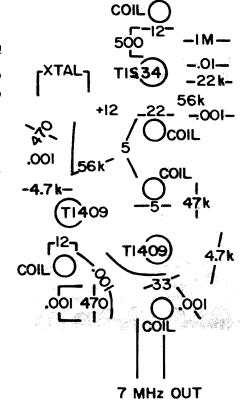
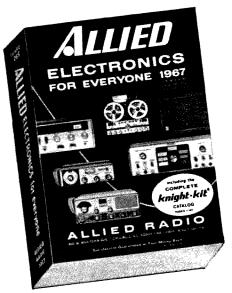


Fig. 3. Component side of the etched circuit board. The coil forms are standard etched circuit types.



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Autostart Teletype Encoder and Decoder

Like to get in on the RTTY fun? Here are a pair of excellent transistor projects that will get you on quickly without fuss and trouble. Circuit board layouts are included and the boards are available if you prefer to buy them. Good for AFSK VHF or RFSK HF.

The VHF amateur who is interested in establishing dependable communications between his friends in his own area should be interested in a method of improving that dependability. It is called autostart Teletype and is used in amateur activities that center around one particular channel which is used by many people as a calling frequency. Although employed to a limited extent on the low bands, autostart Teletype proves to be most useful between club or net members using the VHF bands for local communications.

Autostart means "automatic starting" and this is exactly what the name is meant to imply. As an example, suppose you have a receiver monitoring your favorite channel. While you are out one of your friends calls you on the radio to give you a message. When you don't answer he turns on his teletype tone. Your Teletype machine starts up, prints his message and shuts itself off again, all automatically. When you come home the message is there, waiting to be read. The possibilities of this system are virtually limitless.

Teletype decoder

The Teletype decoder (converter) to be presented here was designed for VHF activity using AFSK* (audio-frequency shift keying). It was revised a few times to make it simpler, cheaper and more compatible with existing

equipment. The result is a solid-state unit which will run for years in continuous use without maintenance. It is simple to build and will cost very little in the way of parts. The printed circuit board for the unit is larger than necessary so as to provide plenty of space for odd-sized parts. It may be copied directly or you may wish to design your own.

The decoder works in the following manner: The input audio is limited, amplified and then split to separate channel filters. Q2 is the 2125-hertz (mark) filter and Q3 is the 2975-hertz (space) filter. The audio is then rectified and filtered to de which is fed to a divider network consisting of two 56-k Ω resistors. With respect to ground, the junction of these two resistors swings positive and negative on mark and space tones.

Transistors Q4, Q5 and Q6 form the dc coupled amplifier which drives the printer magnet and turns the current on and off. The diode D7 helps shut off Q6 completely and also acts as a fuse to protect the transistor junction against execessive currents.

Transistors Q7, Q8 and Q9 also act as DC switches. The zener diode D8 prevents triggering on random noise and voice. The resistor-capacitor network between Q8 and Q9 forms the on/off time constants for the autostart section. There is a delay of about one second from the time the mark tone is applied to the input until the relay pulls in and about three seconds delay for the relay to drop out when the tone is released. These time constants prevent the machine from coming on during noise and

^oIt may also be used for HF frequency shift RTTY by leaving out or ignoring the connections to the autostart circuitry (Q7, Q8, Q9 and the autostart relay).

voice reception and also prevent the machine from shutting off during high space content transmissions.

The relay employed at the output of the autostart section is a small, sensitive, 24-30 volt sealed type which only requires a few milliamperes of current to pull in. If you can't find this type, a higher current relay can be used provided that Q9 is chosen so as to handle the power. The contacts of any relay you use must be capable of handling 110 volts ac at about 2 amps. This means that it will be necessary to drive a large 24 volt relay from the small one if it is used.

Many different types of transistors will work in this unit and I would urge you to try the ones you have before you go out and buy. Except for Q6 and Q9 the parameters are not critical. The type shown in the diagram are the type I used. General purpose, silicon audio types with medium betas will serve just fine. For Q6 a power transistor in a TO-3 case was used. It will require no heat sink. Select one with a low leakage current. For Q9 be sure it will handle the relay current you plan on using. The one specified in the schematic is good for about 50 milliamperes.

Once the components are mounted the decoder can be tested in the following manner. Check all diodes to be sure they are in correctly. Remove Q4 and the zener diode D8 from the circuit and apply power. Place an audio tone of either mark or space on the input and check for audio with a scope or high impedance crystal earphone at test point 1. At point 2 the level should be higher. At point 3 the mark tone should be stronger than the space tone and at point 4 the space tone should be stronger than the mark tone.

Connect a VTVM to test point 5 and switch back and forth between mark and space tone. On mark the voltage should go about 5 volts negative and on space it should go about 5 volts positive (Q4 and D8 must be disconnected for these readings). The swing can be greater, but less than plus or minus 5 volts indicates possible malfunction. If the mark and space voltage at point 5 differ by more than .3 volts it would be advantageous to adjust R1 and R2 so the gain thru both channels is equal. This point is a discriminator type output which, like an FM receiver, will tend to cancel noise and random audio interference.

If all checks out, insert Q4 in the circuit and adjust R12 until the magnet current is 60 milliamperes° with the mark tone on. The value

^oThis will allow either series or parallel configuration on the magnets by simply adding a resistor in series with the magnet for 20 milliampere operation.

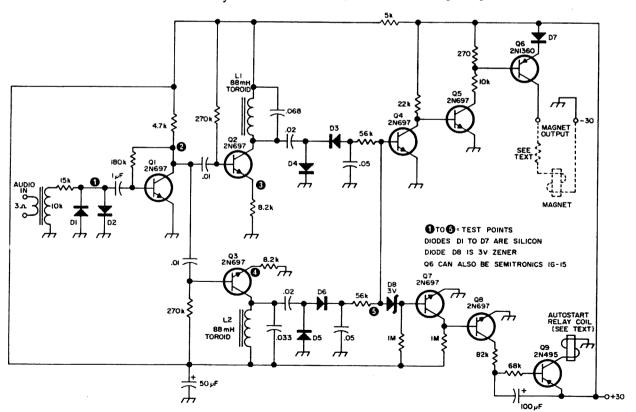
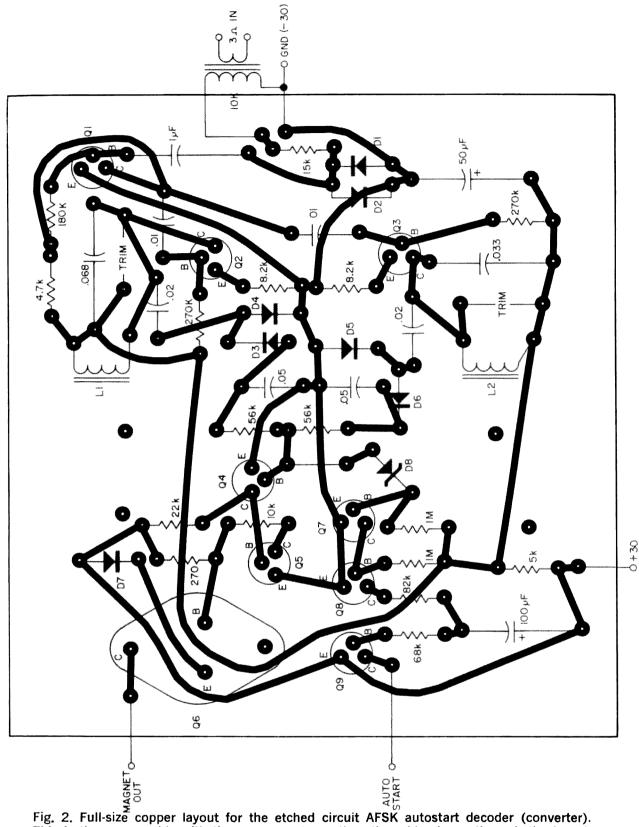


Fig. 1. Schematic of W6AYZ's decoder (converter) for VHF AFSK autostart RTTY. It can also be used for HF RTTY, but the autostart circuitry might prove unreliable for this use, so it's best to ignore it.



This is the copper side with the components on the other side shown through the board.

shown is a nominal value. Switch to space tone and the magnet should no longer hold in, even when manually depressed.

Finally insert the zener diode D8 in the circuit and apply the mark tone to the input. After approximately one second delay the autostart relay should pull in. Release the mark tone and measure the time it takes for the relay to drop out. This should be about three seconds. These times can be longer but will cause trouble if they are shorter.

This completes the checkout of the Teletype decoder and it should be ready to place in service. The range of the machine will be slightly narrower than on local loop but if the decoder is adjusted properly the loss should not exceed 10 points.

Teletype encoder

The Teletype encoder is really an audio oscillator with a transistor switch and is used for the transmission of Teletype signals by modulating the carrier. Two tones are used, the mark tone (2125 hertz) and the space tone (2975 hertz).

The encoder can be built on the printed circuit card or any other way you may choose. Only frequency determining components are critical in this circuit and many types of transistors will work equally well here. The audio output is enough to drive any transmitter including carbon mike types. An external potentiometer should be used to control the level of the generator.

The only difficulty you may encounter is getting Q4 to switch from space to mark. First try a few different types of transistors and if that fails juggle the values of R10 and R12 around. The beta of the transistor is most likely the gremlin in the problem. If it is too low

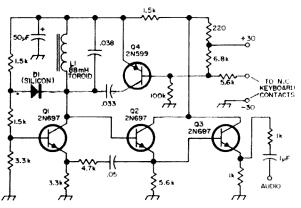


Fig. 3. Schematic of the AFSK RTTY encoder (generator). This circuit generates 2125 and 2975-Hz tones used to modulate AM transmitters for VHF RTTY.

the mark tone will not come on and if it is too high the space tone may not come on.

There are many things you can do with your new system and you will spend many happy months discovering new uses. Nets, field days or just plain fun will convince you that VHF Teletype is most useful and here to stay.

. . . W6AYZ

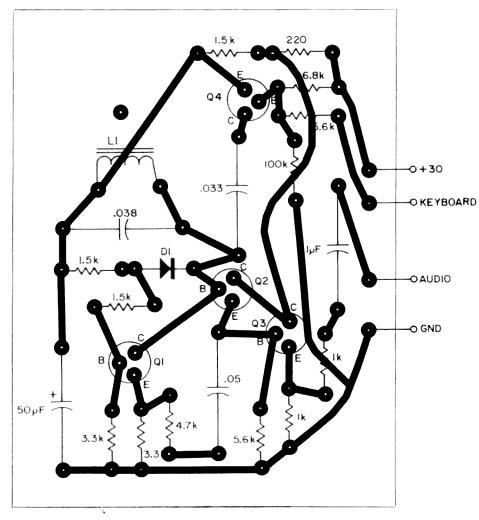


Fig. 4. Full-size Copper layout for the AFSK RTTY encoder (generator). The components are shown in a phantom view from the copper side.

Transistor Tester for VOM's

Check current gain, shorts and opens with this simple adapter.

Like most of you, I have always desired and half-way needed a reasonably good transistor checker. The problem has been that the ones available in the \$7.00 to \$10.00 price bracket are practically useless, and the actual need never seemed to warrant the investment for a decent checker. The checker described here provides a reasonably good solution to this dilemma.

If you have any kind of a junk box, this transistor checker adapter for your VOM or VTVM will cost considerably less than the ready-made cheapies, and it will give more test data. Getting down to details, you can check current gain, determine which junction is open or shorted, and check for leakage.

The circuit

The adapter tester utilizes a standard common-emitter circuit as shown in Fig. 1. Hence, devices are being checked under typical working conditions. Here is how it works. With R4 set at zero resistance, the base voltage will be equal to the voltage $V_{\rm B}$ which is 6 volts (less a tiny drop across R3). Then, depending upon if the transistor is germanium or silicon, there will be from 0.3 to 0.7-volt drop across the base-emitter junction. Thus, with a good transistor in the circuit the remainder of the voltage will be dropped across R5 giving a meter reading of about 5.5 volts.

Checking transistor defects

With S2 in the test position and R4 set at

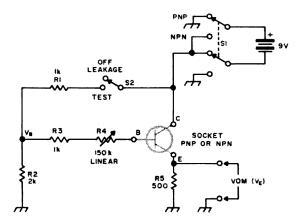


Fig. 1. Transistor tester adapter for use with a VOM.

zero, faults are checked as follows:

- 1. A collector-emitter short will give a meter reading equal to the full battery voltage (9 volts).
- A collector-base short will also yield a full supply voltage reading.
- 3. A base-emitter short will produce a 2-volt reading on the meter. There is no transistor action, hence, R₃ and R5 function as a voltage divider.
- An open collector will also give a 2volt reading.
- 5. An open base or open emitter—no reading.

All of these meter readings are fairly widely spaced for easy recognition of a particular transistor defect.

Accurate beta measurements

By now, you are probably wondering why R4, and 150 $k\Omega$ linear potentiometer, is in the tester. Well, this is used to make rather accurate beta measurements.

By performing a circuit analysis, it can be shown that the voltage $V_{\rm E}$ across R5 is a function of $V_{\rm B}$, R3, R4, R5 and the gain of the transistor. We won't bore you with the math details, just take our word for it. Ac-

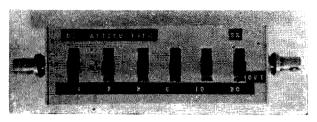
tually, the equation boils down to $\beta=\frac{}{2R5}$ if $V_E=2,$ and, since we have made R5=500 ohms, transistor current gain is equal to R4 in kilohms. Get the idea, all that is necessary to get accurate gain measurements is to calibrate R4 in steps of say $5~k\Omega.$ Then, to measure current gain, simply adjust R4 so that the meter reads 2 volts, and read gain from the calibrated pot. For example, a $50~k\Omega$ reading on the pot (meter set at 2 volts) is equivalent to a current gain of 50.

To check leakage, open S2. A low leakage device will give a very low or zero meter reading. Also, a pair of headphones connected in place of the VOM will give a fairly good indication of transistor noise.

Depending upon the type of meter you own, this adapter checker could be built in a small case outfitted with appropriate plugs spaced to match the jacks on the meter.

. . . Thorpe

George Daughters WB6AIG Will Alexander WA6RDZ 1613 Notre Dame Drive Mountain View, Calif.



Amateur low-power attenuator made from inexpensive slide switches, 5% resistors and fiber glass, copper-clad board.

Low Power Attenuators for the Amateur Bands

Simplified construction, excellent performance and low cost make these attenuators attractive to the ham. They're good to over 450 MHz.

In the evaluation of rf amplifiers, filters and many other devices, a variable attenuator is indispensable. This article describes attenuators built and tested by the authors. These attenuators are flat from dc to over 50 MHz and usable to over 450 MHz. They use low cost parts, are very simple to build, and are more accurate than ordinarily required in amateur applications.

The basic attenuator section is the symmetrical pi shown in Fig. 1. Resistance values are given by the relations:

$$R_1 = R_s (\sqrt{K} + 1)/(\sqrt{K} - 1)$$

 $R_2 = R_s (K - 1)/(2\sqrt{K})$

where R_s is the characteristic impedance of the pad (equal to the source and load impedance) and K is the attenuation factor, P_{in}/P_{out} .

Resistor values for the most commonly used impedance (50 ohms) are shown in Table 1.

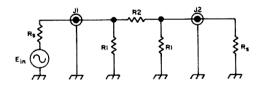


Fig. 1. Basic pi-network attenuator section.

Nominal atten- uation in dB	R: in ohms	R ₂ in ohms	Calculated atten- uation in dB	Measured atten- uation in dB
1	910	6.2	1.1	1.1- 1.2
2	430	12	2.1	2.1- 2.3
3	300	18	3.0	3.2
6	150	39	6.2	6.3- 6.6
10	91	68	10.2	9.6-10.1
20	62	240	19.6	19.5-19.7

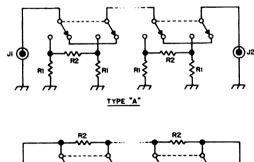
Annenuation measured at 50 MHz and lower.

Table I. Resistor values for $50-\Omega$ attenuators.

Notice that the use of standard value 5% half watt composition resistors allows accuracy within 1 dB of the calculated value of attenuation and within 1 dB of the desired nominal value.

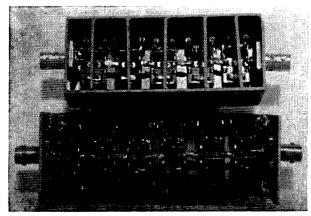
The attenuators are built in small channel boxes made of copper-clad etched circuit board material. Aluminum channel boxes commercially available would probably work equally well. Small, inexpensive DPDT slide switches (H. H. Smith No. 518 or equivalent) are soldered directly to the copper board and the resistors are soldered to the switch terminals (which have been cut short) with the shortest leads possible.

Two wiring variations have been tried, one



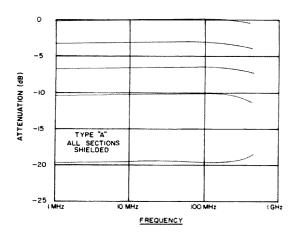
JI RI RI RI RI TYPE "B"

Fig. 2. Two types of attenuator construction. Type A has lower insertion loss than type B at high frequencies, so A is recommended. Resistors R1 and R2 are 5% composition, ½ watt. The switches are H. H. Smith 518 or equivalent. The connectors can be of any type to suit.



Details of attenuator construction. The top style, with complete shielding, is recommended.

with the series resistors (R2) mounted between the switch wiper contacts (type B), and one with all resistors connected to the attenuator in terminals (type A). See Fig. 2 and the photo of the interior of the attenuator. It was found that the latter arrangement, type A, provided less insertion loss than the former at high frequencies, so this type of construction is recommended. Also note that dividing shields are desirable between input and output elements of a single section. These shields prevent capacitive feedthrough at the high frequencies, and are desirable on the high attenuation sections (anything over 10 dB) even at low frequencies. On the low attenuation sections, very little difference is evident below VHF. See Fig. 3 for the attenuation of the attenuators up to over 450 MHz. Building attenuators with greater than 20 dB at-



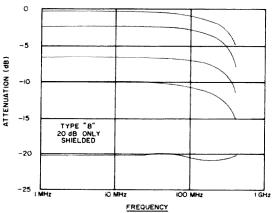


Fig. 3. Insertion loss versus frequency for the two types of attenuator construction: all sections shielded (A) and only the 20 db section shielded (B).

tenuation per section by this method is not recommended for high frequency use.

. . . WB6AIG, WA6RDZ

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An FET S-Meter

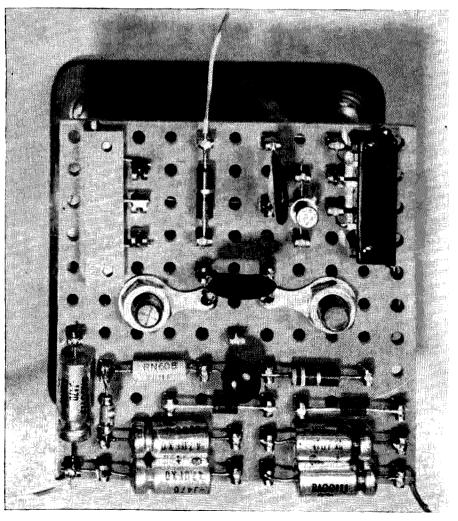
Here's another useful application of field effect transistors.

For the ham "who has everything" the addition of an "S"-meter is no problem; the "S" meter comes with the "S" line. However, for those of us who build our own or modify surplus receivers, adding a signal strength meter is not always an easy task.

Most communication receiver manufacturers design their S-meter into the receiver as an *if* amplifier plate-current meter. This allows the use of a 0-1, 0-2, or 0-5 mA meter movement, which is about the cheapest of the movements. In this type of "S"-meter, the *if* plate current decreases as the (negative) AGC voltage increases. In other words, *the*

meter reads backwards! For a manufacturer making a large production run, "backwards" meters are only slightly more expensive than standard meters; so this simple method has economic advantages. But for the homebrewer of receivers, a standard meter must be used upside-down, and a new scale put on it.

Another approach to an "S" meter is to use the "VTVM," circuit, or differential triode amplifier. Such a circuit can be made to drive the meter in either direction, depending on which meter terminal is connected to which triode. In Fig. 1, the meter is connected as it would be for use with the negative AGC line



FET S-meter circuit built on a piece of Vector board that is fastened to the back of the meter used. The linear, 15 turn pots in the upper corners can be Bourns E-Z Trim types costing only \$1.85 apiece. of a receiver. A variation of this circuit replaces V2 with a resistive voltage divider, as in Fig. 2. In either the circuit of Fig. 1, or that of Fig. 2, an extra tube must be added to the receiver.

One way to implement the VTVM circuit is to remove a dual diode-triode (second detector, first audio amplifier, like a 6SQ7, 6AT6, or 6AV6) and replace it with a compactron and a couple of semiconductor diodes. The newer GE 6C10 and 6D10 are triple-triodes, that could serve as both audio amplifier and VTVM differential. Such a modification requires a socket change, of course.

A simpler solution to the "S"-meter problem has the negative AGC voltage drive a "P-Channel" field effect transistor (FET). The "P-Channel" FET compares to a vacuum tube except that it is a tube's complement. That is, drain (plate) voltage is negative with respect to the source (cathode), and a negative voltage applied to the gate (grid) increases drainto-source current flow. If we use this "P-Channel" FET as a meter driver, negative AGC voltage applied to the gate will increase the meter reading, as we desire.

The FET "S"-meter is shown in Fig. 3. It can be operated from the AGC line of nearly any tube-type communications receiver. Notice that the circuit is complete with a -11 volt regulated supply that takes its power from the 6.3 volt heater circuit. Therefore, only three connections are necessary; heater, AGC line, and ground. The photo shows the circuit as it was constructed on vector board, to mount on the back of a 3", 0-1 mA meter.

In Fig. 4 are shown the characteristic curves for the 2N2606 through 2N2609 family of P-Channel FET's. The family of curves shown really represent only the 2N2608, but by applying the scale-factors in the accompanying table, the rest of the family can be calculated. The near-equivalent industrial versions of these FET's have been added to the table, because these less expensive types are the ones hams will be most likely to use.

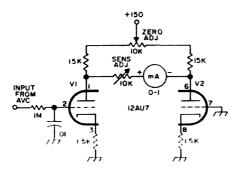


Fig. 1. Typical VTVM or differential triode amplifier S-meter circuit.

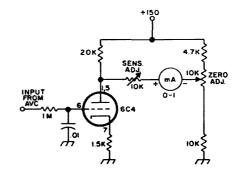


Fig. 2. Variation of Fig. 1 with resistive voltage divider replacing one triode.

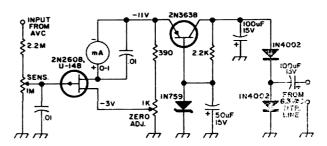


Fig. 3. FET S-meter circuit and regulated power supply that operates from 6.3 volt ac filament line.

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Fig. 4. Characteristic curves for the 2N2606 family of P-channel FET's. The curves apply to the 2N2608 and correction factors as shown in the table at the top should be applied for the other transistors listed.

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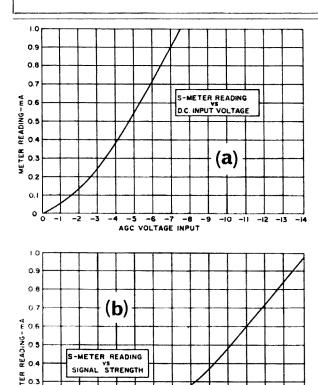


Fig. 5a. S-meter reading vs. dc input voltage. Fig. 5b. S-meter reading vs. signal strength.

-80

Since these four types of Siliconix FET's differ in both price and current ratings, we have a tradeoff situation. The U148 will drive a 1 mA movement, and it costs \$4.10. The U147 will drive a 500 µA movement and it costs \$2.95. The U146 is more expensive than the U147, and has less transconductance, so represents a poor choice for this application. The U149 will drive a 3 mA meter, but the price is \$6.50. The prices of the four FET's and the prices of the various meters must be considered in deciding which to use. It appears that the U147 and a 500 µA meter would represent the best combination, if one is buying all new parts.

The circuit of Fig. 3 was constructed and set up to give a full scale reading of 1 mA when -7.5 V dc was applied to its input. The response is shown in Fig. 5A. With this sensitivity setting, the circuit was connected to an ancient Hallicrafters S-series communication receiver, and the sensitivity curve of Fig. 5B taken.

The curve of Fig. 5B, while nonlinear in terms of mA per dB, is still quite useful. If one really wants a scale that reads "S" units, a paper scale can be added to the meter movement.

. . . **W6G**XN

0.2

0.1

James Ashe W2DXH R.F.D. 1 Freeville, N.Y.

Unwanted Feedback

It's happened to all of us! It happened to me. I built a high-gain audio amplifier. I proudly believed I had thought of everything. Let's see, now. Output and input circuits well isolated. In two separate chassis, in fact. A 140 µF capacitor across the power supply output. Decoupling of all the circuits and double decoupling, with large electrolytics, of the input circuits. Feedback? Hah.

Report: Feedback. Motorboating at two seconds per cycle (½ Hz). Also oscillations at 120,000 cycles per second (120 kHz).

Solution: Imaginative application of the following.

Feedback theory

The key to the entire problem of unwanted feedback lies in Fig. 1. This illustration shows in block diagram form a 'feedback loop'. The two boxes and the circle add up to a circuit having the special property that, in some direct or devious way, part of the output signal finds its way back to the input terminals of an amplifying element. This key concept is applied to any particular problem by looking for the parts of the actual circuit which correspond to the different parts of the diagram.

More complex feedback loops may be made up by elaborating this diagram. But accidental loops are increasingly unlikely in proportion

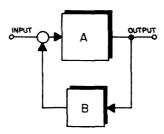


Fig. 1. The basic feedback loop, an essential tool for modern circuit design but a great troublemaker when it occurs accidentally.

to their complexity. Such circuits are used in design work, however, for better circuit performance than single loop designs can deliver. A quite elaborate system is shown on page 42 of the February 1965 issue of Popular Electronics. And Jim Kyle, in his article on selective filters in the July 1965 issue of Electronics World, describes a filter circuit having two feedback loops around a single transistor.

The summing point, represented in Fig. 1 by a circle, is a good place to start explaining this circuit. It is the point where the input signal and the unwanted return signal meet to continue along the same route through the amplifier A, which may be anything from a single transistor to a complete chassis. In feedback problems, the amplifier A probably involves only two or three tubes or transistors. The amplified signal leaving A proceeds mostly to the output, but a little bit of it finds its way back through the return network B to the summing point. The properties of B are very important, since this usually is the part of the loop most easily attacked to get rid of the unwanted feedback.

When the return signal passes through A it is delayed. It comes out a little after it goes in. The signal is further delayed in B, and the total amount of delay has a powerful effect upon the results of the unwanted feedback. For engineering design work, this delay and its detailed effects receive careful attention. It's not so important here, where the major purpose is merely to find and remove the offending, parasitic circuit.

However, one question may be asked. Is it possible that an accidental feedback loop might cause no trouble? Except for unwanted loops whose effects are so weak they cannot be detected or at least do not disturb normal operation of the circuit, the answer is no. The reason is that the properties of accidental loops will generally show a strong frequency dependent factor. If the feedback is strong enough to be noticed, there will almost certainly be one or several frequencies at which everything will add up the worst way. The only safe course is to eliminate the feedback.

For engineering purposes there are several basic types of feedback. These can be sorted out into two types: feedback which leads to oscillations, or positive feedback; and feedback which reduces circuit performance, or negative feedback. There is no reason why accidents of nature or construction should emphasize one over the other. The two kinds are equally likely!

Positive feedback acts to increase circuit gain. In extreme cases it leads to uncontrollable oscillations. Motorboating is a form of

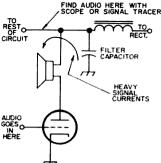


Fig. 2. Showing the route of output stage signal current through the power supply filter capacitor, which feeds audio back to the rest of the circuit.

oscillation, commonly involving a loop through several stages of amplification, and back through a supply line to the input stage. Other effects are increased noise, snapping, clicking and ringing, gain variations greater than control adjustment should produce, and disturbance of tube and transistor operating points leading to severe distortion, or in extreme cases, apparent failure of the circuit to do anything at all.

Negative feedback is less obvious, and may seem to result in improved operation of the circuit. The trouble shows up when estimated circuit gain is much greater than measured circuit gain, when filters show less selectivity than they should be capable of, when gain controls appear ineffective, and when the general performance of the circuit seems to vary from time to time.

Feedback routes

When a feedback problem has been identified, the next question is: which parts of the circuit are involved? In general the exact route will not be obvious, or it would have been eliminated while constructing the circuit. And if a particular lead or component is definitely found to be carrying some unintended signal, is that signal cause, effect, or irrelevant? For example, if the first two stages of an amplifier are oscillating, their signal will be found right down through the rest of the system.

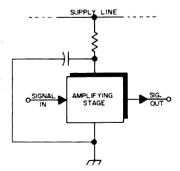


Fig. 3. A single gain or oscillator stage supplied through an isolating resistor and grounded at a single return loop for nearly-perfect isolation. Very good for BFO's.

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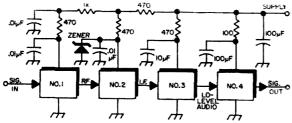


Fig. 4. A decoupling system that might be used in a receiver. Stages 1 and 2 are super-decoupled. The zener improves voltage regulation, spoiled by the decoupling resistors. Zeners are sometimes noisy and should be bypassed in audio and oscillator circuits.

Supply wiring, which goes all over the chassis, is the most likely candidate for feedback routes. In general, this supply wiring is inadequately bypassed. The supply filter will often have the smallest possible capacitors, as estimated from a hum viewpoint. This may be a false economy. For example, motorboating at around twenty hertz is not unusual. What are the reactances of various sizes of filter capacitors at this frequency? A 20 µF capacitor will have a reactance of 400 ohms. A relatively small audio output stage can produce 10 volts across that! And at high rf frequencies supply lead reactance becomes an important factor. Valley and Wallman cite about 8 ohms per inch of wire at 60 MHz. Prorate that to 420!

Common capacitance between two points is another cause of unwanted feedback. Builders of compact equipment probably see a lot of this. Even at audio frequencies two inches or so of clear space between two tubes may not be sufficient. This kind of coupling is avoided by building the system in a straight line, and by some careful positioning of components.

Inductive coupling is a third possibility. All components, from wires to transformers, are surrounded by magnetic fields produced by the currents flowing through them. The field is generally weak and other components are little affected. Sometimes there is trouble. The two cases in which magnetic coupling is most likely are those in which ordinary chokes or solenoidal coils are being used in selective audio amplifiers, and rf amplifiers with tuned input and output coils located on the same side of the chassis.

Waveguide coupling, saved till last, is perhaps the most surprising kind of unwanted feedback. A closed chassis . . . very good practice! acts as a waveguide even though the wavelength may be much greater than its dimensions. It's a very poor waveguide, but it's good enough. Valley and Wallman cite 30 dB

per length equal to width. If the chassis is 5 inches wide, a popular size, that's 30 dB per five inches, far less than the circuit gain now possible in the same distance.

Removing feedback

Very few feedback problems require more than one or two small changes for complete elimination. The problem is to find out what change is required. By putting in additional capacitors, new decoupling, revised grounds, different tubes and transistors, cut and try methods may more or less solve the problem. But there's a better way to do it. Identify the loop and tackle it at its weakest point.

No rules can be given for this. What has to be done depends on the situation. One problem will be obvious, another may be quickly seen through by a seasoned veteran. The third may require the complete treatment by an expert. In general, the method is to disable everything that doesn't seem to affect the feedback, search around in what's left, and try to find out which part of the circuit corresponds to each section of Fig. 1. Here are some hints. Microvolt sensitive VHF converters oscillate at volt, not microvolt, levels. The oscillations are easily picked up with probe or absorption meter. If a supply line is suspected, look at it with a scope. Metal plates will shield electrical and magnetic fields at rf but electrical fields only at audio. A tuning stick, iron slug at one end and brass at the other, can be poked into suspected rf circuits to identify parts in the loop, when a screwdriver or your hand will detune everything. If you can't identify the feedback loop, suspect a wiring error that mimics regeneration. Set an alarm clock; if you haven't licked the problem in two hours, put it away and come back next day.

Summary

A newly completed circuit can be a bundle of joy or occasionally a wellspring of terrible frustration. Do not fear the worst! A careful application of your powers of analysis aided by some theoretical background is the most effective approach to any problems that may arise. Unwanted feedback has a cause, a circuit that embodies that cause, and unless you're terribly unlucky it has a simple solution. Read up, and then go at it!

. . . W2DXH

Bibliography

 Eastman, Fundamentals of Vacuum Tubes, 3d ed. New York, McGraw-Hill, 1949. p. 375.
 Valley and Wallman, Vacuum Tube Amplifiers. New York, McGraw-Hill, 1948. p. 323.

Equipment Protection

Eliminate the devilment of Poof—the Magic Dragon that destroys electronic equipment in seconds.

Something goes wrong in the circuit. The tube plate glows pink, then rapidly red and an orange-white. A bright bluish flicker as the grid shorts to the plate and melts, then all is over. And although your hand was on the plate switch all the time, you never had time to throw it.

Has this ever happened to you? If not, you're an unusual homebrewing ham—or else you don't need to be reading this article. But the odds are it has, at least once. Maybe it was an expensive power tube that went, maybe a power transformer—but few of us have escaped what the reliability engineers call "catastrophic failure" of a component at least once.

The reasons for protective circuitry are obvious; the one most often thought of is to protect the shack from fire caused by overload wiring. Others, frequently of more practical importance, include protection of individual components (such as tubes) from overloads, and the protection of complete items of equipment (such as power supplies) from the same source of possible harm.

To achieve all these aims of protective circuitry, the conventional power-supply-primary fuse (the one most often included in the rare cases that any fuse appears at all) is not enough. After all, a fuse which will permit enough power to pass to light several dozen watts of heaters can hardly protect a screen circuit from a 60 mA destructive overcurrent!

On the other hand, individual fusing of each stage could rapidly turn into a supercomplex project when the full complement of gear in a well-equipped station is considered. Obviously, some form of compromise is necessary.

The nature of this compromise is such that you'll have to determine for yourself just where to make it. To give you the information on which to base your decision, let's look at the places that fuses can provide protection.

Fig. 1 shows a typical HV power supply, while Fig. 2 is a partial schematic of a transmitter's rf section. The possible places for fuses are indicated in each case.

In Fig. 1, note that each transformer is individually fused. While this admittedly requires a few more fuseholders and fuses, it also allows you to install a fuse which will pass the required amount of current to each transformer, yet will blow on slight overload.

The secondary fuse shown from center-tap to ground in Fig. 1 protects the transformer itself against overload; if its value is properly chosen it can also protect the chokes and (to a lesser extent) the rectifier tubes.

In Fig. 2, the fuse in the driver plate circuit serves a dual purpose. It protects the tube against extreme overloads, while protecting the power supply and divider circuitry in case the tube shorts out.

In the final, two fuses are recommended as shown. The one in the screen circuit should be selected to blow instantly when maximum screen input (determined from tube charts) is exceeded. When you realize that high-power tetrode can destroy itself within less than a second with excessive screen current, you understand the necessity for a fast-acting fuse here. The plate-circuit fuse, on the other

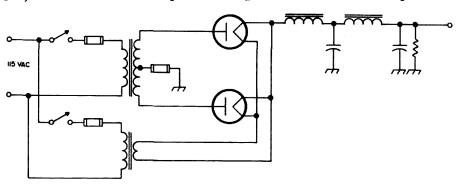


Fig. 1. Fused power supply.

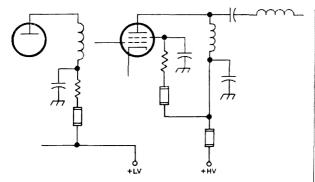


Fig. 2. Fusing the transmitter.

hand, offers only conventional overload action. If protection of the supply is the major item of importance, all the low-power stages can be grouped through a single fuse. If, on the other hand, protection of the tubes is the important thing, then a separate fuse in each circuit is the way to do it. Usually, you'll want to protect the final tube, but in the driver stages it may be more worthwhile to simply protect the supply and let the tubes take the risk.

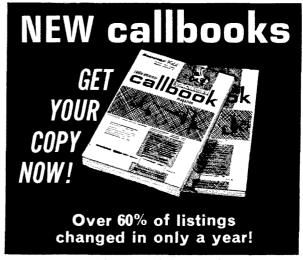
In the case of receivers and test equipment, the power supply fusing shown in Fig. 1 is usually adequate. This is especially true if the secondary fuse is chosen to just pass the normal maximum operating current so that it will blow at overload.

At this point a look at some of the various types of fuses is in order. The "ordinary" fuse actually comes in three varieties—and use of the wrong type can easily rob you of the protection you think you have.

Most widely known, of course, is the garden-variety fuse. This type normally carries its rated current without damage, but blows within 10 seconds when double the rated current flows. More severe overloads blow it faster, but the time required to interrupt the circuit seldom falls below a couple of seconds.

When protecting equipment which cannot stand such overloads for even this short time, the "fast-acting" fuse is the one to use. This type has a spring in it to speed the action (in the smaller sizes, the spring may consist simply of the fusible wire itself) and may be used to protect the screen circuits of such power tubes as the 4X250 and the 4-1000.

Circuits containing heavy inductive loads, such as motors which must start under load, frequently draw 10 or more times their rated current at the instant they're switched on. If either a normal or a fast-acting fuse is used to protect such a circuit, it would blow every time the switch were thrown. The "slow-blow" fuse was developed for this type of circuit; it withstands heavy overload for several



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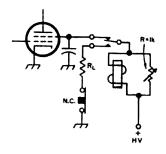


Fig. 3. Homebrew overload relay.

	Example	
Relay coil:	5000 ohm @ 3 mA	
R setting (ohms)	Trip current (mA)	RL (ohms)
1000 500	18 33	50 x HV 28 x HV
300 100	53 153	18 × HV 6 × HV

seconds and blows only on sustained overload. Such fuses have no place in radio circuits; they're mentioned here only to warn you against them. Many a lost power tube can be traced to the inadvertent use of slow-blow fuses in screen circuits!

So far, we've talked only about fuses. This suicidal little component is one of the simplest and surest ways of protecting electrical circuits—but it's not the only way.

Another protective device which does the same job but doesn't destroy itself in the process is the circuit breaker. Within the past few years, small circuit breakers have been developed for television sets which trip at 2 or 3 amps and can be purchased for only a dollar or two at most suppliers. These are ideal for primary-circuit protection in power supplies wherever their ratings apply.

A similar device is the overload relay; this can be a special unit (with correspondingly high price) or, in many cases, can be a conventional relay wired to interrupt the critical circuit whenever current drain exceeds a specified limit and to then hold the circuit broken until it is reset. Since such a device acts faster than most fuses, it is correspondingly better for screen-circuit protection. Fig. 3 shows one way of using an inexpensive relay in such an application. The pot across the coil acts as a shunt and is used to set the current at which the relay will trip. The normally-closed pushbutton is the reset switch. The load resistor (RL) is chosen to draw slightly more current than the tripping value, to insure that the relay remains closed after it trips.

Often, the circuit to be protected with a fuse, breaker, or overload relay happens to be one in which you would also like an indication of relative current flow. If the accuracy of a meter is not required, and if the current flow is normally between about 30 and 250 mA, you can kill two birds with a single pellet by using

an ordinary pilot-lamp bulb as a combined "meter" and fuse.

These bulbs are normally rated for currents of 60, 150, and 250 mA. At half rated current, they emit a readily visible dull red glow. At rated current, of course, they have their normal appearance. At approximately 25 percent over rated current, their light becomes a searing blue-white, and if the current goes much higher they burn out as rapidly as an ordinary fuse.

Thus a 60 mA bulb provides a good indicator in the range from 30 to 75 mA, with protection at about 100 mA. A 150 mA bulb covers the range from 75 to about 185 mA, blowing somewhere around 250 to 300 mA. And a 250 mA bulb covers the range 125 to 310 mA, letting go about 450 mA or so.

It's best to use the highest-rated bulb that will give you both the indication you seek and some measure of protection, because bulb life is related directly to current flow. At 5 percent under rated current, bulb life doubles—but at only 5 percent above rating, the life of the bulb is cut in half! This means that, at 200 mA in the circuit, a 250 mA bulb would outlast a 150 mA bulb by dozens of times over. However, it would require half again as much drain to blow.

In the old days, before World War II and the resulting inexpensive surplus meters, this bulb-fuse trick was widely used in even sophisticated gear. Now, it's hardly ever seen. However, it's still good and is especially handy in portable and mobile apparatus where it helps hold down size and weight.

Since the bulbs do have limited life, it's recommended that you use sockets for them. The socket can easily be mounted on a quarter-inch standoff insulator, providing a handy tie point for the high-voltage line.

Incidentally, you don't need to worry about the voltage rating on a bulb used in this application; it will take care of itself when rated current flows. As a case in point, the author has successfully used a single 250 mA bulb in the high-voltage line to a pair of 6DQ6's operating at 500 volts, 200 mA. Once the parasitics were removed from the rig (they turned the bulbs brillant blue instantly), bulb life proved to be almost indefinite. And as an aside, the variation in brightness during tuneup was far easier to see than the gyrations of a plate meter!

Which brings us to the end of this roundup of equipment protection tricks and techniques. Remember, next time you build something—put in what the designers left out! It's not only safer that way, it's cheaper, too!

. . . **K5JK**X

An Etched Circuit UHF Dipmeter

These dippers cover 130-480 MHz, yet aren't critical, hard to build or expensive.

In the December 1965 issue of 73, Paul Franson WA1CCH, described a simple UHF dip meter. It worked well, but was difficult to package satisfactorily. I did some playing around with the circuit and found that it wasn't hard to modify it slightly, put it on an etched circuit board, and make a nice looking, convenient set of VHF-UHF dippers. The etched circuit board construction makes the dippers easy to duplicate, and the flat, U-shaped inductors are convenient to fit into tight places that conventional coils can't reach.

For a discussion of the circuit, see WA1CCH's article. There was a minor error in the article. In **Fig. 1**, the oscillator should be described as a grounded base rather than as grounded emitter oscillator.

I made three models of the dipper. They cover 130-175 MHz, 175-250 MHz, and 250-480 MHz. The first two models use the same size inductor, with the 130-175 MHz model using a larger capacitor for tuning with a ce-

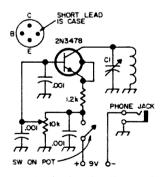


Fig. 1. The etched circuit dipper is very simple. The circuit is almost identical to the one described by WA1CCH in the December 1965 73, but the construction is quite different. C1 is Johnson 160-104 (9 pF) for the two higher frequency dippers, and 160-107 (14 pF) for the 130-180 MHz model. There is a trimmer across C1 in the 130-180 MHz model; see text.

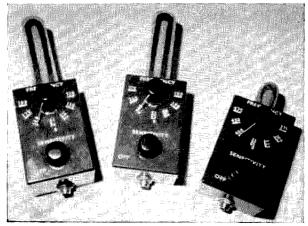
ramic trimmer across it. This trimmer is not shown in the schematic; its value is 7-45 pF and it should be adjusted to cover the proper range.

The 250-480 MHz dipper uses a smaller inductor than the others. It also has a copper jumper (shown in the layout) that the lower frequency dippers don't have.

Each dipper is complete (including the battery) except for the meter. The meters were omitted to save space and money, but can be included if you wish to use a slightly larger case.

Each dipper uses one RCA 2N3478 NPN silicon transistor. These transistors cost only \$1.90 apiece, but it's likely that other transistors that are even cheaper could be used. The 2N3478 has odd basing—the only reference is the short case-shield lead—so don't shorten any leads until you're sure that you can keep track of the connections.

The copper side of the board for the dipper is shown in Fig. 2 with the component side in Fig. 3. You can buy the boards already etched for \$1 apiece from the Harris Co., 56 E. Main



The three dippers shown here cover 130-480 MHz.

St., Torrington, Conn., or make your own. Use glass or Teflon based board. Paper or bakelite board probably wouldn't be satisfactory. Trim the board to the proper shape with a nibbler. The inductor should be coated with coil dope to keep from shorting it when you use it.

To mount the boards, you'll have to cut a thin slot near the edge of the Minibox used as a case. One way to do it is to drill a number of holes of the proper size in a row, then use a file to finish the slot. You'll have to bend that side of the Minibox out to get the board in. It's held in place by an extra set of nuts on the shafts of the potentiometer and the tuning capacitor. Be sure to trim the leads projecting from the copper side of the board so that they won't touch the metal of the case. The battery is held in place with a simple clip made from scrap metal.

The dipper is very easy to use. But before we get to that, let's check it out and calibrate it.

Plug a 2 to 5 mA meter into the meter jack. You can use a more sensitive meter if you shunt it with a resistor that gives the proper scale. Put the resistor across the meter jack terminals in the dipper if you use the meter for other things.

Turn on the dipper by twisting the potentiometer knob clockwise until it clicks. The meter should show very low current. As you turn the pot, the current should suddenly jump to about 1 mA. That means that the transistor is oscillating. If you touch the coil, the meter reading should drop and the dipper may stop oscillating completely. Now tune the capacitor through its range. There should be a little variation in current, but not too much.

Now you're ready to calibrate the dipper. The easiest method is a sensitive wave meter that covers the range, but it's quite easy to do the job with a TV set. A TV set covers 176 to 216 MHz (channels 7-13) for the low calibration. Then the second harmonics of the dipper tuning 235 to 445 MHz can be received on a UHF TV set (470-890 MHz). If you have a two meter receiver, that gives you another maker at 146 MHz. You can put on the panel markings with Ami-Tron or Datak rub-on lettering.

The dipper should be complete now, and ready for use. Bring the dipper near a resonant circuit in the dipper's range and tune the frequency control. You should get a prominent dip in current when both circuits are tuned to the same frequency. The amount of dip depends on the setting of the pot in the dipper, the distance from the tuned circuit, the Q of the circuit, and the type of coupling.

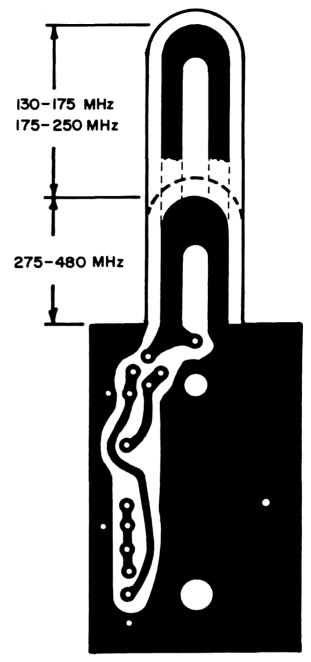


Fig. 2. The copper side of the etched circuit board used in the dipper. This layout is full size. Use board suitable for these frequencies: fiber glass or Teflon. You can buy boards already etched, but not drilled or trimmed to size, for \$1 apiece from the Harris Co., 56 E. Main St., Torrington, Conn.

In many cases it's easiest to leave the dipper stationary and tune the other circuit.

The dipper can also be used for monitoring AM transmitters by plugging a set of headphones in the meter jack and adjusting the tuning and pot. You can also use the dipper for determining the frequency of another oscillator. Simply tune the oscillating dipper with headphones plugged in until you hear a slight



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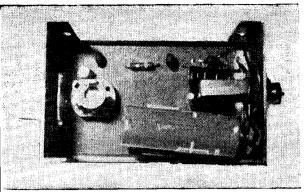
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Here's the inside of one of the dippers.

click. You probably won't be able to get a zero beat at these frequencies.

Be careful that you don't use the dipper around an energized transmitter of more than a few watts output or the dipper may be damaged.

These dippers are simple, inexpensive and non-critical to build. After you've build them, you'll wonder how you ever tried to build UHF equipment without a good dipper.

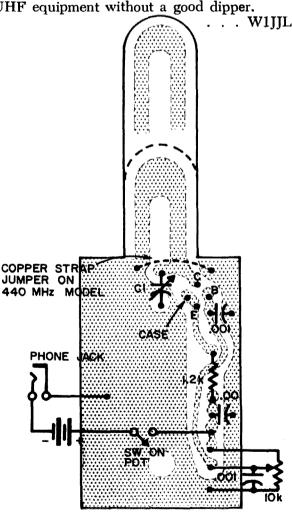


Fig. 3. Component side of the dippers. There is a 7-45 pF ceramic trimmer across C1 in the lowest frequency model. See the text.

Hamming VK9-Style

How'd you like to have to put up an 85 ft. tree trunk for your antenna tower without any skilled help or machinery? Read how they did it on New Guinea.

Truthfully, there is something dramatic about operating a DX-station, but after some of the nasty pile-ups, one soon begins to lose that spine-tingling experience. However, it is still fun to work DX when the conditions are good and some of the signals are of fabulous strength. Then too, while operating a DXstation in Australian Territory, one really begins to respect the capabilities of the Australian gallon, 150 watts. A person can do so well with 150 watts that he might be accused of running a kW, such as I was accused of on a number of occasions. (Incidentally, I had an HT-37, Johnson match-box and rhombic about 5,000 ft. above sea level.) Speaking about power capability, I am reminded of the time when two Florida stations were "chewing the rag" and I heard, "Yeah, we know those fellas in Australia. . . . They say that they run only 150 watts. It's impossible to work DX unless you have a kW."

During the course of the conversation I learned that both operators were running a kW and they lived only a couple of blocks away. I guess they were carried away and forgot the possibility of having an audience and were unaware of being copied all the way down in New Guinea. Anyway, I enjoyed myself and laughed myself sick during the whole conversation. The crowning-point of the whole incident would have taken place if I would have broken in the QSO. I'm sure that there would have been a lot of "hms and haws"

especially if I would have told them,

"The rig here is an HT-37, 144 watts dc."
But I didn't break, however, I had a ball of a time enjoying the QSO of two fellows with the shoe-fever.

I suppose all of the kW-boys have stopped reading. But don't take offense fellas, and be assured that if I could have a kW in New Guinea, that there wouldn't be a happier man. Really, I would be satisfied with a half-agallon, but "it's agin the law." Besides it's more fun working with low power after you get an S9-plus report and you are able to say, "144 watts here."

Another thing which makes life in DXterritory interesting, is the lack of equipment and parts. It's a lot of fun to be able to scrounge around gathering parts, bits and pieces for a master plan. There are no tube checkers, generators kick-out, there is poor regulation on the ac power supply and you blow up the dc power supply on the rig, etc. I remember the time that I blew up one of my silicon rectifiers. . . . I felt like I lost my right arm. But I had a left-handed substitute, an old 5R4G, which I was fortunate enough to have with me. Yes sir, there are no parts stores around here. About the only thing that we have around the corner in New Guinea is maybe a banana tree.

Assembling and erecting antenna systems are no snap either. You don't have ham-

friends to help you when your station is miles from nowhere. As a rule I didn't need an antenna party since labor is cheap in New Guinea. The only problem is that one can't persuade the natives to readily produce said cheap labor.

One of my first antennas was a vertical ground-plane. I built it with scraps of wire, nylon cord from an old parachute, pieces of scrap timber, a few old nails and no soldering iron. It's surprising what one can do while in a pinch. The VGP wasn't too good, though. I was able to get the thing up only 8 feet. The best report that I got was a 5/9, but the usual report was 5/5 to 5/6 and very often the report was 5/3. The good Lord knows how many stations I tried to call and wasn't able to raise with the VGP.

Then I decided to raise the VGP to 50 feet. It took me about three weeks of half-hearted labor from the natives to cut, trim, and drag in a 55 foot tree. After we finally got a hole dug (I had to do most of it myself), I corralled a bunch of school kids from Fatima College. I was superior of the college and the kids had to show-up or else. After raising the pole a few degrees, I was able to mount the VGP. Then in a matter of a few minutes I had my 50 foot VGP. It's surprising what a couple of hundred kids can do if you give them a little direction. But to make a long story short, the VGP was not the antenna for me. Reports were similar to the 8 foot VGP. I guess it was the location in the Waghi Valley. Even though I was located 5,000 feet above sea level the valley mountains bottled-up the rf quite well since the mountains towered over my location another 3,000 to 5,000 feet in some places. With the mountains to the north and the south the only good direction for propagation was toward the east, and a little south of east. Big deal! True, I contacted some of the stations from state-side but signals were poor. The reasons for poor transmission and reception could have been a poor location, poor conditions, or maybe the antenna wasn't up to snuff, and possibly everything together. Your guess is as good as mine in this matter. But one thing I knew for certain was that my heart was not set on developing the VGP. I suppose that I could have narrowed down some of the possible aggravating factors which were causing trouble to the antenna system, but I soon gave up after toying with the probability of moving a mountain or two. But I didn't look at the situation as hopeless. If one can't move a mountain one can still move away from the mountain.

The day of moving to a new location finally came. My stay at Fatima College was com-

pleted and the superior, whose place I was taking, returned to New Guinea. I was then re-appointed to a mission station called Minj. What a place! It was situated on the south wall of the Waghi Valley with a clear shot to the north and northeast. Shortly after I arrived at Minj I hung up an old scrap antenna and fired up the SX-I00. . . . What a shock! Fabulous! State-side was smashing in 20 to 40 dB over S9. Real state-side QRM! That did it. The next day I called for the local tribe leaders and told them that I would like to have four long poles in a week. Surprisingly, the fellows agreed, naturally, for a price. After the leaders left I immediately started digging in my junk trunk. By the time I finished I found enough wire for the big move. I was so happy that I could have jumped up and clicked my heels, but then I began to feel sick with disappointment. Where was the wire for the feed line? Then there was a bout of turning trunks upside down, and clawing through my belongings in hopes to find that wire. Just then, during the height of the confusion, my houseboy arrived on the scene. It was apparent to him that I was looking for something and he asked whether or not he could help. I explained what I was looking for, the roll of wire and all that. The boy got the message for I sensed that the boy felt as if he had done something wrong. Sheepishly, the boy said, "I put that wire in a box in the Tool shed." Man, I could have skinned him alive! But anyway it was a relief to find that wire for the feed-line. Now I could build myself an antenna, the antenna I always dreamed about-the rhombic.

Having located all the wire, parts and rough materials, I was far from being finished, so I discovered later. If anyone tried to cut 6" x ½" spreaders for a fifty foot feed-line, he will know and understand what I mean, especially when all one has is a hack saw and a jack knife. Man, that fiber board was tough!

Finally the poles were brought in and they ranged from 45 feet to 85 feet. They were perfect since I had to build the antenna on the side of a hill and this would help me to shoot the rf over the other mountains in the horizon rather than burn all the grass in the valley. There was still some time left that day after the natives brought in the poles so I had them prepare four big holes and everything was finished by late afternoon. The boys were tired so I thanked them and told them to go home and rest up so that they would be fresh the next morning for the antenna raising.

That night, although I was tired, I was not able to get to sleep. I guess I was a little anxious about the new rhombic, but the big-

gest problem that bothered me was getting up that 85 foot pole in such a way that there would not be a funeral after the antenna raising. Morning came too soon. I was happy with the fact that I would have my first rhombic, but inside I was sincerely hoping

that nobody would get hurt.

It was about 8 o'clock that day when about 15 fellows showed-up. Since I wanted to get the job moving we began on the 45 foot pole. In about 45 minutes or so the pole was pulled into an upright position and secured. The boys were really keyed-up so we tried our skill on one of the 65 foot poles. It went up beautifully, and hardly a sweat! Shortly after we got the second pole in an upright position the other mob came, so off we were grunting and pulling with a snort now and then and finally got the third pole up. Three poles were up and it was just a little after 11 o'clock in the morning. As far as I was concerned we did pretty good so I told everybody to knock off for a while to rest. Usually the natives are only too ready to knock off from work, but this time one of the tribal leaders said that the men would rather work since they were all loosened-up. It was unanimous that they wanted to finish the job and go home. Surprised, but slyly happy, I went over to the big 85 foot pole and tied the rope at about the 65 foot mark. The natives were a little suspicious whether we would be successful in raising that pole (I could feel the unrest), but most of them were too proud to "chicken out." I suppose that I felt the same way. Everybody lined up and ready, I gave them the go-sign and with a big shout everybody heaved and began to ease up the pole. It was amazing how easily the pole went up, but then we hit a stand-still. When the pole was raised to a 45 degree angle all progress stopped. We pulled and shouted, pulled and shouted again, but we couldn't budge the pole. This went on for about a half an hour. Actually, it was then that I seriously doubted whether we were going to raise the pole. Sort of disgusted 1 told the men to secure the "X" supports and tie-up the rope to a stake. Then we rested for a few minutes and got our breath. In the meantime I went around among the natives and told them of the story how all the kids raised a pole while I was staying at the Fatima College QTH. I guess I rubbed the fur in the wrong direction with that school-kid stuff, because everybody went to the pole and lined up and were waiting for me to give the sign to heave. Man, you should have heard those natives shout, snort, grunt and wheeze! Those fellows dug in and raising the pole was like letting it fall. The pole was

then straightened and secured. All the poles were ready. Everybody was feeling good, they had a right to, since this was a tough job, and most of all, nobody was hurt. After a job well done I paid everybody. The total cost was \$10.00 and a carton of smokes.

But the job was not finished yet. We had to string up the antenna. I suppose that I could have had the wires and insulators mounted before we raised the poles but I was afraid that things would get tangled and the ropes on the pullies would run off the wheels. I didn't like the idea climbing an 80 foot pole without any climbing gear so I asked for volunteers. For a while I thought that I was going to get stuck with the job, but my bossboy shyly stepped forward and volunteered. Why he was so shy about the whole business beats me. In a matter of about a half an hour that fellow shimmied up those four poles, tied insulators and pulleys, and fed the nylon cord through the pulleys as if it were nothing at all. He and I were good friends from then on. A guy like that is valuable if a pulley jams on an 80 foot pole.

After that we spread out the rhombic, then we went to the feed point and tied in the feed-line and hoisted up the ladder-like outfit. Finally we went down the side of the hill and wired in the terminating resistor (a blob of carbon resistors soldered in parallel, series, and any other way possible). Up went the terminated end, and the pulley ran smoothly. Everything was tightened and the rhombic looked beautiful. I finally had my rhombic!

Since it was nearly sun-down and time to turn on the power, I made a mad dash to the shack and made the necessary connections. After having fired-up the generator, I came back to the shack and tuned up the HT-37. It took me a while to fiddle with the Johnson match-box, but it was worth it. The SWR at the feed-point was 1 to 1! I then tuned around on "20" and heard KC6BK, old Stan from Ponope. Excitedly. I zeroed in on Stan's frequency, switched over to vox control and shouted,

"Break, Stan!"

"Man, who is the breaker?", replied Stan. I was able to feel that Stan was surprised, so elatedly, I answered,

"VK9TG, Stan. How copy?"

"How do I copy! What did you do? You sound like you are running a kW."

Man, I felt like a guy with a brand-new 40 element beam for "20"!

That's when all the DX-ing started, Good old Minj—the best DX and rhombic location a ham could have. ... VK9TG

SINPO and SINPFEMO

It seems that the old faithful RST system of signal reporting is questioned quite regularly as to its effectiveness in communicating the desired meaning. As we all know, it is capable of communicating only three elements of information—those pertaining to readability, strength and tone. However, because of the general laxity of its use, the RST report seldom conveys any useful information at all.

You CW operators look back over your log for the past few weeks of operation. You will find (unless you have an extremely strong signal or an unusually weak one) that over half your received signal reports were 579. When I receive a 579, it conveys a single bit of information to me: "I am too lazy to carefully examine your signal and give you an accurate report; therefore, I am taking the easiest way out." This same fellow who gives you a 579 report can turn around and lose you completely on your next transmission! Strange, isn't it?

Let's take a close, objective look at the three elements of the RST system, and see how our amateur fraternity is using them.

R-readability. The average ham, even while digging through several layers of interference to copy you, will give you an R-5 if he can copy as much as 75% of your transmission. If he copies less than 75%, but more than 50%, you are R-4. If you are practically unreadable, he will give you an R-3 report.

S is for strength. About 95% of the S reports on CW fall within the range of S-6 to S-9.

Hams are just too friendly to come right out and say, "You have a weak signal." This situation points out that the old five-point (S-1 to S-5) scale was better, since the five levels of that scale were generally used. We could go back to the old five-point scale at the present time simply by subtracting four from the present S reports. Thus, most reports would become translated to the range of S-2 to S-5.

T stands for tone. Most ham signals originating from the USA today are either T-8 or T-9. Since few hams realize the stringent requirements for a T-9 signal, all of these T-8 and T-9 notes get grouped in the T-9 category. If a ham has a signal like a buzzsaw going through ten-penny nails, he might get a T-7 or T-8 report. Again, hams are too good-natured to come out and say, "I have heard better notes come out of a soprano saxophone with a split reed." So for all the use it gets, the T might just as well be dropped from the RST system.

The above comments pertain to normal operation. There are two cases which lead to slightly different but equally consistent RST usage—contest operation and reports to DX stations.

During contests, most CW reports are either S-7 or S-9, with R-5 and T-9 reports in all cases. One ham told me he gave *everybody* a 579 report during contests, and I'm sure he isn't the Lone Ranger.

When working non-rare DX stations, ap-

	S	1	N	_{.g} P	0
Rating scale	Signal strength	Interference (QRM)	Noise (QRN)	Propagation disturbance	Over-all readability (QRK)
5	Excellent	Nil	Nil	Nil	Excellent
4	Good	Slight	Slight	Slight	Good
3	Fair	Moderat e	Moderate	Moderate	Fair
2	Poor	Severe	Sever e	Severe	Poor
1,	Barely audible	Extreme	Extreme	Extreme	Unusable

Fig. 1—SINPO signal-reporting code for CW.

	S	I	N	P	F	E	M	0
Rating scale	Signal strength	Interference (QRM)	Noise (QRN)	Propagation d _i sturbance	Frequency of fading	Modulation quality	Modulation Depth	Over-II rating
5	Excellent	Nil	Nil	Nil	Nil	Excellent	Maximum	Exectient
4	Good	Slight	Slight	Slight	Slow	Gcod	Good	Good
3	Fair	Moderate	Moderate	Moderate	Moderate	Fair	Fair	Fair
. 2	Poor	Severe	Severe	Severe	Fast	Pcor	Poor or nil	Poor
1	Barely audible	Extreme	Extreme	Extreme	Very fast	Very poor	Continu- ously over- modulated	Unusable

Fig. 2—SINPFEMO reports for phone operation.

proximately two points may be added to each element of the RST system (i.e., a domestic 347 signal is identical to a DX 569 signal). For rare DX stations, this increases to four added points per element. If the reporting station does not have a QSL from the country in question, another two points may be further added to the S scale, and an X appended to the tone report.

Now that we have made this studied analysis of the existing situation, and have discovered the fallacies in RST usage, let us take an objective look at the hams' need for reporting. As mentioned before, the quality of most ham signals today is very good, with either no defects at all or slight, unobjectionable ones. Because of this, there is no need for commentary on signal quality (i.e., note) in the normal report. Rather, it should be commented upon as an exception, whenever necessary. The primary purpose of the report then is to communicate the factors related to the copiability of the signal—the signal strength, the readability, and any reduction of readability due to interference, noise or propagation disturbance.

A system of reporting that meeting these requirements was proposed in London away back in 1953 by the Comité Consultatif International Radio, in their recommendation number 141. This recommendation was for the SINPO reporting code for use with CW signals. This system covers Strength, Interference, Noise, Propagation disturbances, and Over-all readability-each on a five-point scale Further, the CCIR proposed simple one-word definitions of each point of the scale, rather than the long explanations of the RST system. The SINPO code is shown in Fig. 1. The advantage of the SINPO code is that it not only tells you what your signal strength and readability are at the receiving stations, but what type of degradation is present.

The comments thus far have pertained primarily to CW operation, although many of them can be applied equally well to phone

operation. One exception is the signal strength reporting on voice. A report of "sixty dog biscuits over sugar niner" means, "I have a meter attached to my receiver with a very wide scale and markings up to 80 or a hundred on it." Some of the more forward-thinking receiver designers are considering S-meters with scales starting with S-9 at the meter zero point, and divisions at 25 dB intervals, up to 500 dB above S-9.

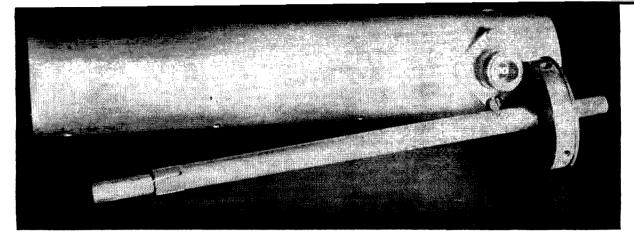
In any event, the CCIR did not forget phone operators in their recommendation number 141. They provided the phone men with the SINPFEMO signal-reporting code. This system covers Strength, Interference, Noise, Propagation disturbance, frequency of Fading, modulation quality (E) and depth (M), and an Over-all rating. The rating scale is shown in Fig. 2.

The SINPFEMO code provides all the advantages of the SINPO code, plus the ability to comment on modulation quality and depth—something that has long been needed in phone reporting. It is to the operator's advantage to keep his modulation quality high and percentage of modulation as near 100% as possible, and a SINPFEMO report would help inform him how successful he is in maintaining an effective phone signal. Such a system is especially needed on the VHF bands, where modulation is generally of poorer quality than that of the average high frequency phone station.

A few months ago, I received an SWL card from what was obviously a brand-new and self-taught short-wave listener. His signal report was a carefully thought-out and critical one based on the SINPO code. It won't take this young squirt long to join the conformity that is amateur radio and start giving 579's to all CW stations (for the short time he continues to use this bourgeois mode of transmission), and multitudinous dog-biscuits to all phone stations.

Me? I enjoy being a non-conformist!

...DJØHZ



Frank Jones W6AJF/AF6AJF 850 Donner Avenue Sonoma, California 95476

432 MHz Antenna Filter

The 432 antenna filter unit shown in the June 1966 issue of 73 magazine functioned all right on low power and for receiving, but tended to drift in tuning with high power transmitter service. This single tuned coaxial 432 MHz cavity should have an unloaded O of about 4000 and when loaded down to a working Q of 40 or so, will have quite lowloss (a fraction of a decibel). The detuning with from 100 to 150 watts of carrier on phone and 300 watts or more on cw going thru it produces very little effect. The heat loss is quite small. The photograph shows an unassembled line with the inner variable length line and shorted end piece lying in front of the outer shield. It is a quarter wave line which can be adjusted from 6 inches to over 7 fnches in length to tune the cavity to exactly 432 MHz. All copper and brass tubing was silver plated.

The outer tube was made of brass 1% inches in diameter and about 8 inches long. Two coaxial type N fittings were mounted about one inch from the shorted end. A piece of number 12 wire about 1% inches long, bent into a flattened loop, connects from the center connector back to one of the type N mounting screws on each fitting. The 12 wire was made to parallel the inner conductor of the coaxial line but not touch it. Two % inch diameter holes in the outer shell permits some adjust ment of coupling by shoving vigorously with a small screwdriver against the coupling loops.

The inner line was made of % inch OD material, rather thick walled with saw slots in one end. The other end was silver soldered into a piece of 1/16 inch thick brass which had been turned down to a snug fit for the large outer pipe. This inner line extends up about 6 inches from the brass end plate. Originally the end piece was drilled and tapped for

three 6-32 mounting screws. Later it was modified to have 6 mounting screws. This whole unit was silver plated also.

The adjustable line was about 5/16 inch in diameter and about 8½ inches long. It makes a nice snug fit inside of the ¾ inch diameter section with a friction bearing from the slightly pinched-in ends of the saw slots. This is the rf connection and is near the high voltage end of the quarter wave circuit where the current is low. This adjustable line was also silver plated heavily. It is adjustable by pushing or pulling the rear extension part. The outer large section should be more than a quarter wave long and acts as a coaxial shield around the tuned inner conductor. The actual resonant length of the inner conductor will be about 6¾ inches long for 432 MHz.

The filter should be connected into a 50 ohm coaxial line at the antenna side of a coaxial antenna switch. This puts it into the circuit for both transmitting and receiving. The input and output links should be long enough to load the filter circuit to some value of Q=30 to 80. This means good attenuation of undesirable signals outside of the 432 MHz (narrow band generally used).

The loading as well as resonant length adjustment can be made with either a transmitter or receiver. The length is set for maximum signal from the antenna into a 432 MHz receiver. The link coupling is adjusted to give minimum loss when the filter is in the antenna feeder as compared to no filter. A good SWR-power meter can be used with a transmitter to make these same adjustments as a double check. Measure the forward power into and out of the filter and also the SWR at both points. These pairs or readings should be practically identical with a well designed SWR meter in these tests. . . . W6AJF

64 73 MAGAZINE

Six Meter Final Amplifier

Get up to 75 watts output on six with a few watts input.

So many final amplifiers built today are complicated and difficult to adjust. The unit described here is very straightforward and extremely simple to construct and put into operation in your station. A few watts of CW input will give about 75 W output in class C service.

The final tube used can be either an 829B or 5894. The latter is easier to use on 50 MHz as it needs no neutralization. This is a prime factor for selecting the 5894 as neutralization can lead to the crazy house long before perfection is achieved! The bias is obtained by rectification of input power, and the 6BQ5 clamp tube protects the 5894 if drive disappears.

Layout is not critical and can be arranged to suit you. The clamp tube can be mounted under the chassis if necessary. I built my amplifier on a 7" x 11" x 3" chassis. This allowed

Bob is a professional organist. He's worked for the past seven years for the Holiday Inn motel chain. He was once associated with the VHF Amateur and was CQ's VHF SSB editor.

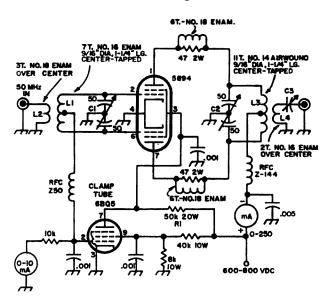


Fig. 1. 5894 six meter amplifier. The same basic circuit can be used with an 829B (or 3E29), but some changes will have to be made in the coils and resistors.

ample space for the power supply at the rear with the amplifier placed up front. It was then mounted in a regular 19" rack panel but could be placed in a cabinet for table top use.

The grid components are mounted underneath the chassis and the plate components are above so that no interaction between the two occurs. The plate coil and capacitor is mounted up front on the panel with the grid components behind the 5894 as viewed from the front. A long phonelic rod is used to connect the grid tuning capacitor to the front panel so all tuning can be done from the front. An alternate method would be to mount the grid tuning capacitor on the chassis so the shaft would be accessible from the top of the chassis directly behind the 5894. The 6BQ5 is mounted to the left and behind the 5894. This allows for short leads between the two tubes.

After construction, insert the tubes and begin checking the unit by using a grid dip meter to set the resonant frequency of the coils and capacitors. Adjust the maximum dip at 50 MHz for both capacitors. At this time, apply filament voltage and check to see that both tubes are lit. Apply plate voltage only after making certain that the unit is connected to a dummy load and the exciter has been connected at J1. Then apply plate voltage and no excitation. The 5894 should draw approximately 20 to 30 mA. Begin loading with loose coupling to the antenna. Apply full grid drive to 5894 and dip the final loading control, C2. Adjust coupling for a plate current reading of approximately 180 mA full load with a plate voltage of 600 V. If trouble is experienced in obtaining these readings in standby condition due to the value of B+, adjust R1.

When using the amplifier on any mode of operation, the clamp tube will be a vital asset as it will always protect the 5894. The setting of R1 in the initial tune up procedure will limit the 5894 to draw only 20 to 30 mA with "key up" condition. This is ample to cut the tube completely off and allow for a safe and sane operation of your new final amplifier.

Have fun in your construction and enjoy its ease of operation and the terrific results for such little effort. . . . K9EID

JANUARY 1967 65



The Drake 2-NT CW Transmitter and 2-C Receiver

When the new Drake 2-NT transmitter and 2-C receiver arrived the other day, I had to rush right home and hook them up to an antenna. I have a base-loaded multiband vertical on 80 and 40, so I didn't know how well I'd be able to work out. After a quick perusal of the excellent instruction books, and connecting them together for semi break-in CW, I was all set to go. A quick three by three call on the 80 meter novice band netted three callers up and down the band; a WN1, a WN3 and a WNØ. I called the WNØ and asked the others to QRX. It turned out that the WNØ was out in Colorado and had never even heard a station from New Hampshire. After exchanging reports we had a nice little rag-chew at about 13 wpm. The 2-NT held up very nicely with 75 watts input—I was running 569 out in WØland. Next the WN3-nice report from Philadelphia, 589. The WN1 was almost next door, so the 599 report wasn't too surprising. And so it went, nice reports from novices all over the country.

Next I changed the tap on the vertical and tried forty meters. Lots of QRM, but when I found a clear spot, the 2-NT didn't have any trouble at all working out with very nice reports. The excellent sensitivity of the 2-C picked up the weak ones and the selectivity took care of any adjacent rock crushers. Then up to 20, 15 and 10. For these bands I plugged in a VFO so I could move around a bit, connected up the tri-bander and looked

for some DX around 14010. I heard lots of Europeans coming through; a short call to a PAØ in Rotterdam resulted in a 559X report followed by several stations calling from DL, SM and OZ lands. After cleaning up the minor pileup, I moved up to 15—same story in Africa. Some nice reports on the 100 watt signal from ZS6 and 5A3 stations. By this time it was pretty late in the evening so ten meters was pretty well closed down; I didn't hear any stations on CW, and very few on phone. Perhaps some other time.

After using the 2-NT for several hours, a few of the hidden features that aid in operating ease become apparent. Basically this transmitter is no different from many other low power CW transmitters; however these hidden features make all the difference in the world. Essentially, the transmitter is a three tube affair, with a crystal oscillator, driven amplifier and final power amplifier. The driven amplifier output and power amplifier input circuits are broadband tuned circuits that are factory adjusted, so no tuning is required by the operator. The pi-network in the output of the power amplifier is designed for 50 ohm coaxial lines, and the loading of this network is also factory set. All the operator has to do is turn the rig on, tune the plate tuning capacitor for a dip in plate current, adjust the power set for the desired power input, hook up the antenna and go on the air. And, if you don't want to tune for meter dip, you can

tune for maximum brilliance of a built-in neon bulb. Operation is simplicity in itself and it takes longer to read about it than to do it. In addition, no external antenna changeover relays or receiver muting switches, no added TVI filters or "harmonikers"; they're all included inside the 2-NT!

The 2-NT transmitter uses grid block keying and extremely clean, crisp CW is obtained by a special pulse and delay circuit. Additional features of this circuit are afforded by the relay which it controls. This relay switches the antenna from transmitter to receiver, mutes the receiver, turns the sidetone off and on in time with your keying and grounds the cathode of your VFO if you use one.

A built-in transistorized 900 Hz phase shift oscillator generates a sidetone which may be used for monitoring your keying. There is a connector on the rear of the 2-C receiver for the sidetone signal; on other receivers it should be connected to the arm of the audio gain control. With these connections, the receiver works normally during receiving, but when it is muted for transmitting, the sidetone comes through the phones. In addition, when the transmitter is placed in the standby position, the 2-NT may be used as a code practice oscillator in conjunction with the receiver. In this mode, the key only controls the sidetone oscillator; none of the other stages are energized.

Another operating aid is the spot switch. With this switch you can spot the frequency that you are operating on without transmitting a signal. It is always good operating practice to listen before transmitting, and the spot switch on the 2-NT allows you to do just that. Only the low power frequency determining stages are energized during spotting, no power is applied to the final stage.

All in all, the 2-NT transmitter is one of the easiest to operate that I have ever used. All the controls have a purpose, and all the set and forget type controls have been adjusted at the factory. In addition, no accessories are necessary to put an outstanding signal on the air. For the novice, the 2-NT appears to be an ideal starter transmitter; even many generals will find it to their liking.

The Drake engineers really put their heads together when the 2-C receiver was on the drafting boards. What they have come up with is a neat combination of vacuum tubes and transistors that does a tremendous job. Vacuum tubes are used throughout the amplifier, mixer and if stages, but transistors take over in the high frequency oscillator, detector, BFO, AGC and audio stages. A total of five tubes and seven transistors do the bulk of the job; along with eight diodes for detecting and rectifying duties.

The rf lineup is relatively straightforward; a 12BZ6 rf amplifier, a 12AU6 high frequency mixer, two 12BE6 converters, and a 12BA6 50 kHz if amplifier. The two inputs to the high frequency mixer consists of the output of the rf amplifier and the output of the 2N3394 crystal oscillator. The output of the mixer stage is 3.5 to 4.0 MHz. This 80 meter signal is mixed with a 3955 to 4555 kHz VFO in the first 12BE6 for a 455 kHz if output. The second 12BE6 converter accepts either a 405 or 505 kHz input to put a 50 kHz upper or lower sideband into the 12BA6 if amplifier. A 50 kHz bandpass filter in the 12BA6 input provides an adjustable passband selectivity of

Drake 2-C Specifications

Frequency 3.5-4.0 MHz, 7.0-7.5 MHz, 14.0 coverage: -14.5 MHz, 21.0-21.5 MHz and 28.5-29 MHz with the crystals

provided. Accessory crystals will cover any 500 kHz segment between 3.0 and 30 MHz.

SSB, CW, AM, RTTY

Selectivity: Selectable passband filter provides: 0.4 KHz at 6 dB down and 2.7

KHz at 60 dB down. 2.4 KHz at 6 dB down and 9.0

KHz at 60 dB down.

4.8 KHz at 6 dB down and 16.8 KHz at 60 dB down. Less than 100 Hz after warm up

Stability: or for 10% line voltage change.

Less than 0.5 µV for 10 dB signal Sensitivity: plus noise to noise on all amateur

bands. Calibration:

Main dial calibrated 0 to 500 KHz in 10 KHz divisions; vernier dial calibrated in approximately 1 KHz divisions. Both the main dial and

vernier are adjustable for calibra-

tion purposes.

Amplified AVC system has slow or AVC: fast discharge and less than 100 microsecond charge. Less than 6 dB audio change for 100 dB rf

input change.

4 ohms output impedance. Audio: watts with less than 5% distortion.

50 ohms nominal. Antenna input:

Spurious

Modes:

Image rejection greater than 60 responses: dB; if rejection greater than 60 dB on amateur bands. Internal spurious signals less than equivalent 1 µV signal on the an-

tenna.

5 tubes, 7 transistors and 8 diodes. Lineup:

Accessories available:

2-AC 100 KHz calibrator, 2-LF low frequency converter, 2-CQ speaker/Q-multiplier and

filter, and 2-NB noise blanker. Power

requirements: 120 volts, 50 to 60 Hz, 30 watts. Size and

 $11-5/16 \times 6-9/32 \times 9-3/32$ inches. weight: 13½ pounds.

Drake 2-NT Specifications

Frequency coverage:

CW portions of the amateur bands

from 80 through 10.

Input power:

Variable to 100 watts. Plate current meter redlined for 75 watts

povice limitation

Modes:

Break-in CW, semi break-in CW or manual CW.

Features:

Automatic transmit switching, builtin antenna changeover relay, sidetone oscillator, frequency spotting, built-in low pass filter and sim-

plified tuning.

Antenna output

50 chms nominal.

impedance:

3 tubes, 1 transistor and 5 diodes.

Accessories

available:

Antenna matching network, VFO.

crystals.

Power

requirements: 120 volts, 50 to 60 Hz at 2.8

amperes.

Size and

weight:

9% x 6-9/32 x 9-9/32 inches. 121/3

pounds.

either 400 Hz, 2.4 kHz or 4.8 kHz at the 6 dB points.

The sensitivity and selectivity of this lineup is really tremendous. The 0.5 µV sensitivity for 10 dB signal plus noise to noise on all bands from 80 through 10 really pulls in the weak ones. Like the old adage says, if you can't hear 'em, you can't work 'em. And after a few minutes warm up, the drift is not detectable; even with a 10 volt change in line voltage the drift is only barely perceptible. When a strong local comes on the 2-C performs admirably. The 12BZ6 contributes a great deal to this because of its low intermodulation characteristics, but the variable passband filter does most of the work. When the going really gets rough, you can turn it down to the 0.4 mark; in this position the bandpass is still only 2.7 kHz wide 60 dB down.

The amplified AVC systems works extremely well. When the stations are weak, there is almost no AVC voltage applied to the rf and if stages, but let a strong signal come on and immediately it is at a comfortable listening level. In fact, there is less than 6 dB audio change for a 100 dB change in rf level. To give you an idea what this means, 6dB is about the difference between programming and commercials on TV; 100 dB is the same as comparing a 1 watt transmitter to a ten trillion watt transmitter; for different types of operation, the operator may choose slow or fast AVC release times, or he may turn the AVC off.

The 2-NT transmitter and 2-C receiver, working singly or as a pair provide an extremely convenient and economical starter station for the novice. And when the novice advances to the general ticket, many will find that this equipment is still ideally suited to their needs. For ssb and RTTY operation, the 2-C stands up right along with many of its more expensive cousins, so when the general ticket arrives there is no need to go out and buy another receiver. For portable or field day operation the pair is ideal. They are compact, easy to tune, require a minimum of outside accessories and require a minimum amount of power; perfect for low power gasoline genera-. . . W1DTY tors.

Space Age Soldering

1 read K4CPR's article in the March 73 and it inspired me to look up the methods for space vehicle soldering. When you are putting equipment into orbit every solder joint must be perfect. This is how it is done.

Given-a cruddy old resistor to solder into the circuit.

- 1. The part to be soldered is never handled with the bare fingers. This puts oil where you want the solder. You use a pair of gloves or nylon finger cots when touching the leads.
 - 2. Choose a soldering iron:

Wire gage 20 and smaller 35 watts Wire gage 20, 16, 14, 12 50 watts Wire gage 12, 10, 8, 6 100 watts Wire gage 6 and larger 200 watts

- 3. Take a pink pearl eraser and shine the area to be soldered.
- 4. Dip a brush in trichloroethane, or equivalent, and wash the area to be soldered.
 - 5. Take another brush and coat the area to

be soldered with liquid rosin base solder, MIL F 4995.

- 6. Heat the iron, dip the tip in liquid rosin flux, apply solder to the tip of the iron, and wipe it clean on a damp cellulose sponge.
- 7. Tin the lead to be soldered by putting a heat sink next to the body of the resistor, apply rosin core solder to the iron tip, and within six seconds apply the solder to the wire for five seconds only. If you are not able to apply the solder within six seconds, wipe the iron clean and start with fresh solder.
- 8. After tinning the lead solder the part within an hour. If this is not possible wash off the flux with trichloroethane and reflux when you are ready to solder. After soldering the connections wash off the flux with a brush and trichloroethane.

If you follow the directions you'll find they work just fine but I find a good sprinkling of profanity to be of great service.

. . . Del Wininger WB6JNI

A Simple Voltage Calibrator

Are your meters lying to you? Most likely they are. In this article Jim discusses the causes and results of meter errors, and shows how they can be overcome.

There is a remarkable likeness between the archer who is aiming for his target and the amateur designer who wants to design a circuit. Both follow a procedure which is only partly based on clear, sharp textbook theory. Each depends heavily on intuition, on accumulated habits derived from previous successful experience. The archer who practices with crooked arrows can only hope to succeed in an average sort of way, with many discouraging events to try his patience and interest.

Not all instruments are accurate. There are various kinds of inaccuracy, and as with other machinery, the properties of instruments tend to drift with time. Calibration may also be violently altered by laboratory accidents. Suppose two meters which once behaved identically no longer do so. Which is wrong? Could they both be wrong? It appears that a third party, rather isolated from the usual events of the lab, is required. This article describes a sort of secondary voltage standard, very good in proportion to its cost and effort of construction.

Some notes on meters

The problem of meter calibration is best viewed against a brief background of some facts about meters. Further perspective devel-

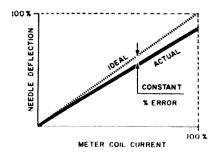


Fig. 1. Performance of a wrongly calibrated but linear meter.

opment would result from a review of material appearing in handbooks and textbooks.

It may come as a surprise that all moving coil meters are current-sensitive devices. They do not respond, except indirectly, to voltage. They appear, sometimes, to respond to voltage because of the constant influence of Ohm's Law upon the circuit, but in fact they are only indicating the current passing through them. This is because each meter movement contains, as an integral part of itself, a fixed magnet. A coil moving in the magnetic field experiences a force proportional to the current passing through the coil. Voltage does not produce a magnetic field as does current, so that conventional meters respond to current, not voltage.

Another valuable point will appear upon close examination of almost any multimeter, de ammeter, or other indicating device. It is the fact that the scale is linear. That is, the angular deflection is directly proportional to the applied voltage or current. The divisions across the scale are equally spaced and each one represents the same increase. By contrast, an ohms scale on the same meter will be nonlinear: the range from zero to five ohms at one end may take up as much scale space as 200 ohms to infinity at the other end.

Meter manufacturers are very interested in linear meter movements. Design and calibration problems are simplest if a linear scale can be used with a linear movement since only a single adjustment is required to calibrate the entire instrument. This is the common full-scale adjustment, a simple calibration performed to bring the full-scale reading into agreement with the full-scale voltage or current. The manufacturer wishes to produce thousands of similar meters with least expense and effort; the user would like to check the entire calibration with one measurement. This is not possible if the meter response is curved,

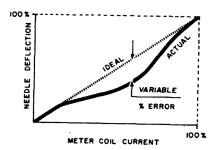


Fig. 2. Performance of a "rightly calibrated" but nonlinear meter.

since then the degree of curvature has to be measured, a much more complicated business than a single point calibration.

In 1882, D'Arsonval called attention to the virtues of a certain type of meter movement which combined durability, simplicity, linearity, and relative immunity to outside effects. It is now known by his name, and is used in virtually all meters made. This movement is mentioned in many publications, described in a few, and is very well worth looking up. An old pre-1900 physics or science book will yield surprising and interesting information on the elaborate predecessors of today's apparently simple multimeters.

Meter error

There is no such thing as a perfectly accurate meter. The readings of a particular meter may be accurate, for instance, within 10%, 3%, or 0.5%. The price rises rapidly as the accuracy improves, but there is no meter at any price without error. In order to keep the picture simple, the source of the error can be neglected, and reference made only to the reading observed on the meter together with its dependence on the applied current. Then the observed error can be broken down into three types: stiction, calibration error of a linear meter, and linearity error of a "properly calibrated" meter.

Stiction is observed in this way: you place the probe in the circuit and observe a reading. Without disturbing anything else, you tap the face of the meter with finger or a pencil; the reading creeps upwards slightly. The explanation is sticky friction: you can experience much the same thing by sliding your hand along a smooth surface. If it moves in a series of starts and stops, that is stiction. Another example is the peculiarly unpleasant way in which fingernails slide along a blackboard. Obviously this has no good function in the meter's bearings and much effort is made to eliminate it. Particularly in the less expensive meters the effort may not be so successful. Sometimes a read-

justment of the meter bearings will improve the situation: this is very, very much like gambling, if you're not an expert. When making accurate readings, always assume there is some stiction and tap the meter face or the panel nearby. Use something light and don't overdo it.

There is a sort of relation between calibration error and nonlinearity. The separation made here is for purposes of explanation, and in any discussion of one the other should be assumed just offstage, waiting eagerly for an opportunity to make an unobserved and frustrating entrance.

Fig. 1 shows what is usually meant by calibration error. We assume that the meter's characteristics are strictly linear. That is, that a 1% increase in current through the meter produces a certain swing of the needle which is the same anywhere on the scale, and the swing is through an angle just 1% of the total swing from zero to full scale. That means the meter's characteristics will plot out as a straight line, shown as a dotted line labeled "ideal". The solid line labeled "actual" shows the performance of a meter with a calibration error. This kind of calibration error is usually corrected by a trimmer device added somewhere in the immediately adjacent circuit.

Fig. 2 shows what is meant by nonlinearity error. Note the full scale reading is just what it ought to be. Zero is also where it belongs, but there is a rather irregular deviation above or below the ideal between these extremes. When you have finished the Calibrator, you will very probably find this type of error in at least one of your instruments. If this error appears in a vacuum tube voltmeter or its solid-state equivalent, perhaps it can be reduced by a trial-and-error interchanging of tubes or transistors.

It is important to retain a correct perspective when dealing with calibration problems. A diagram like Fig. 3 is very useful, because it shows that a deviation of perhaps one tenth volt can be a large error at the low end of the

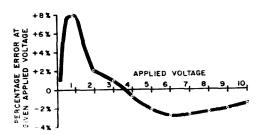


Fig. 3. Performance of a popular multimeter as measured with the Calibrator. Note unexpectedly large error at the low end of the scale.

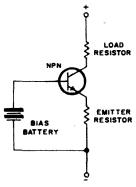


Fig. 4. Skeleton circuit of the Calibrator.

scale and a trivial error at the high end. Calibration and linearity checks will be most meaningful if plotted in this way. This curve was derived from a real instrument, a popular multimeter priced at \$16.88.

Calibration using fresh batteries

It's popularly believed that fresh batteries can be used as accurate calibration voltage sources. This is partly true, but it is not true enough to meet modern requirements. The reproducibility of electro-chemical reactions and the similarity of one production-line item to another seems to imply that two batteries from the same manufacturer or even from two different manufacturers ought to be as like as two peas in a pod. Or at least that such differences as appear ought to be in some respect other than terminal voltage.

But differences do appear. Some policy has to be adopted permitting important differences to be weeded out from insignificant ones. Microvolt differences are clearly unimportant; differences of a tenth or a half volt clearly cannot be tolerated if batteries of around 1.5 volts are going to be used for calibration standards. It seems reasonable to suppose that for general-purpose work, a calibration source should be accurate within 1% or better; that is, at 1.5 volts the extremes would be 15 millivolts each way. A significant factor in thinking about tolerances is the possibility that one calibration may end up at one extreme, and some other calibration at the opposite extreme. An accuracy of 1% does indeed seem to be the upper limit on tolerable error for calibration purposes.

A large number of fresh pencells, standard carbon-zinc D cells, and assorted mercury batteries were tested to determine likely variation in terminal voltage. Variations as great as 50 millivolts were found in cells from the same box. This amounts to a range of nearly 2% each side of the mean voltage for that batch,

and since few amateurs will have a method for determining whether the average is correct or skewed, it appears that the idea of using fresh dry cells for calibration purposes has been exploded. Perhaps it would be preferable to say the idea has been well undercut; the fresh cells are better than nothing but they appear to be not as good as a serious worker should require.

Calibrator circuit theory

This calibrator uses an unusual method for generating its output voltage. In most such devices, a voltage-determining circuit feeds the output directly, or is followed by some resistance-divider device to generate the variable output. This is a simple scheme, basically, but it suffers from a significant shortcoming. Calculation of the change in voltage due to load tends to be difficult, because there is no simple way to estimate the properties of the standard at most settings.

If the electronic circuit is designed to standardize a current rather than a voltage, Ohm's Law and the resistor manufacturer's engineering tend most reliably to the conversion of the current into a voltage. Computation of the error due to passage of some of the current into a load circuit becomes very simple if a wise choice of circuit parameters is used. In the case of the Calibrator, a constant current of 5 milliamperes is supplied to a 2000 ohm potentiometer. high-quality ten-turn thousand-point scale (one hundred points, per turn, ten turns) thus cranks out 2 ohms per division from zero, and the voltage across this resistance is just that produced by 5 milliamperes less whatever current is delivered into the load.

The basic circuit of the Calibrator is shown in Fig. 4. A voltage reference source and a transistor fix the voltage across the resistor R. The transistor acts as an emitter follower. Since the voltage across R is fixed, the current through it is also fixed. The same current flows

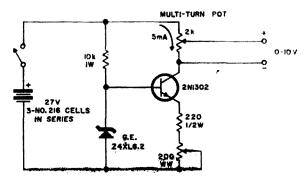
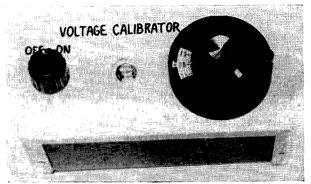


Fig. 5. Complete circuit of the Calibrator. Most of the parts are completely uncritical.

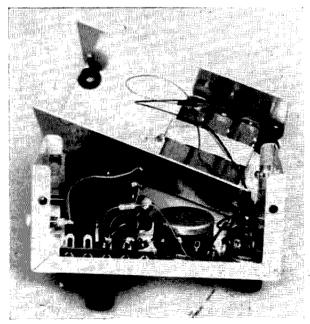


The finished Calibrator. The dial reads 2.20 volts. Adjustment for accurate output by screwdriver pot in the center of the panel.

through the load resistance that serves to convert the current into a voltage.

Fig. 5 shows the complete circuit, hardly more complicated. The resistor in the transistor emitter circuit is split into one fixed and one variable resistor, to permit vernier adjustments in current. The transistor base voltage is fixed by a zener diode, and a resistor has been added to supply the necessary zener current. A non-critical battery and a switch complete the circuit.

The voltages across the circuit have to add up to the battery voltage. From the battery to the zener biasing resistor, down through the zener to the other terminal of the battery, is the complete biasing circuit. Since the transistor has a beta of 100, it draws negligible current from the zener. It is only necessary for the zener to be safely out of its knee region; but not too far because current in this



Inside the Calibrator, showing point-to-point wiring.

circuit loads the battery with no return in

The other current route is down through the load resistor, the transistor and the emitter resistor. Since the voltage across the emitter resistor is fixed by the transistor, the base-emitter voltage remains fixed at about 0.2 volts, and the voltage across the load resistor is fixed by the constant current through it, the only voltage that can vary as the battery ages is the transistor collector voltage. But collector voltage variations have practically no effect on transistor current. So long as the transistor remains within its operating range, the circuit works.

There are some nearly invisible secondorder effects. The only one worth mentioning is a slight drift over the first few seconds after the Calibrator is turned on, due to the zener and the transistor warming up.

Calibrator construction

There is nothing critical about layout and construction. For best results, new parts are preferred, but junkbox or surplus parts should yield perfectly good results in all cases where you are properly suspicious and apply careful tests to the components. Since this circuit is a little bit odd in comparison to most of those appearing in the amateur literature, it might be breadboarded before construction and a few tests performed to clear up the facts about its performance. A milliammeter and a Diddlebox1 in series with the transistor collector circuit will show clearly that the current is remarkably independent of changes in collector load, so long as the transistor is biased into its operating region.

The calibrator is built in a 2½ x 2½ x 5 inch Premier Minibox. The wirewound calibration pot and the multi-turn pot plus two insulated lugs on a standard lug strip provide enough terminals for point-to-point wiring of the entire circuit. A solid bracket holds three standard 9-volt transistor batteries in the bottom piece of the case; three 8.4 volt mercury batteries could have been used. They hardly seem to be required. The Calibrator is highly valuable when needed, but it does not receive the steady use of a VTVM or a scope.

Two GE zener diodes were purchased for this project, just in case. It turned out that one of them had a knee at around 7 mA; the other at well under 1 mA. This is within specs; they are apparently tested at the factory at 20 mA. The lower current is preferable; the zener

Diddleboxes are discussed in the April 1966 issue of 73, page 48.

has to hold the transistor base voltage only against a few tens of microamps plus the transistor leakage current of a few microamps.

If a zener other than the specified GE Z4XL6.2 is used, an appropriate revision of emitter resistors is very simple: the total resistance should be chosen for zener voltage less 0.2 V base-emitter voltage at 5 mA or whatever other fixed current is chosen.

If a surplus transistor is used, a fairly high beta is preferred, but not over 200 or so. It should show low leakage current; in any batch of ten or twenty similar transistors at least one will show up with good beta and remarkably low leakage. Choose that one. If the emitter resistor takes up six volts and the multiturn pot takes up 10 volts, the rest of the battery voltage has to appear at the transistor collector terminal. In the schematic of **Fig. 5**, this is about 11 volts. Some surplus computer transistors are good for only 15 volts.

Finally, if a surplus pot is used, it should be checked for noise and erratic operation. Put a battery across its terminals at sufficient voltage for a few milliamperes through the potentiometer. Add a load resistor or perhaps 20 k Ω from its slider, and listen with a signal tracer. A slight, almost musical, noise is permissible; erratically noisy regions or spots are grounds for rejection.

Calibration

A few final tests will quickly indicate whether the circuit is operating properly. A milliameter in the transistor collector circuit should show constant current against variations in battery voltage. Placing an additional resistor across the zener biasing resistor for a 10% current increase should have no more than a barely discernible effect upon collector current. Perhaps you can think of one or two other tests.

The calibration procedure is simply a matter of adjusting transistor current through the multiturn pot to the correct value. This may not be quite 5 mA, or it may be a little over, because of the 3% or 5% tolerance on overall resistance of the pot. This tolerance has nothing to do with the 0.1% or better linearity tolerance, which determines the accuracy of intermediate readings. The transistor current is adjusted to give a correct reading at any fixed pot setting, preferably full scale. Unlike many meters, the linearity of the pot is guaranteed, so that the full scale calibration is reliable in this case.

Of the various possible sources of known voltages or accurate indications for calibration purposes, batteries have already been dis-

cussed. A calibration may be performed by comparison with some meter believed to be correct, but this is a somewhat risky procedure. An expensive or a new meter is more probably accurate than an old or inexpensive one, but there is a distinct element of risk that cannot be eliminated when calibrating in this way.

A better and more reliable source of accurate voltage is a standard cell. High school physics laboratories frequently have inexpensive but quite good standard cells available, or one may be purchased from a scientific supply company. They are sealed in glass and last for many years if they are not subjected to overload, extreme high or low temperatures, or excessive vibration. The manufacturer is generally very specific as to what constitutes abuse and his notions should be respected. In most cases, a load of 10,000 ohms is about the minimum; this draws about 100 microamps from the usual approximate 1.0183 volts.

Fig. 6 shows a circuit for calibration by standard cell. The switch is a normally open push switch so that current is drawn from the standard cell only for brief periods. Any 0-50 microammeter will do. To make the calibration, the Calibrator dial is set to the standard cell voltage and locked in place. The vernier calibration pot is adjusted for a barely perceptible upscale deflection of the meter. Then the 4.7 k Ω resistor is shorted out, and the vernier calibration pot readjusted for a zero reading. This completes the calibration. The microammeter reading goes to zero because the Calibrator on one terminal and the standard cell on the other are putting out the same voltage: no current flows if no potential difference exists.

An amateur or experimenter sees a potentiometer as a resistance with a slider supplied in a little case and capable of a few percent resolution. A more elaborate potentiometer, perhaps costing over \$1000, may be found in the high school or college physics laboratory. If one is available, certain accessories required for its use are probably also on the premises, and it may also be used for calibration of the Calibrator. Some reading in appropriate physics texts will be required, but potentiometer theory is not elaborate and you should have few difficulties with it.

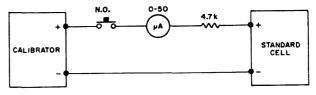


Fig. 6. Circuit for calibrating the Calibrator from a Standard Cell.

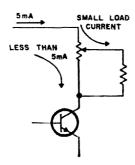


Fig. 7. Loading the Calibrator reduces its output voltage exactly in proportion to the current sidetracked around the multiturn potentiometer.

The very nicest instrument for calibration of the Calibrator is a digital voltmeter, frequently referred to as a DVM. It usually contains its own standard cell, and its design is inherently accurate. After checking the DVM calibration, connect it to the Calibrator, set the Calibrator to 9.95 volts, and adjust the vernier pot until the DVM gives the same reading. Then, just for kicks, crank the Calibrator pot down to various lower readings and watch the DVM produce readings agreeing within a millivolt or two. It's very impressive.

Operation

The calibrator dial reads 0-10 volts in ten turns of 100 points per turn. That is ten millivolts per point, one volt per turn. This direct reading is very convenient! It is the reason for choosing a scale of 0-10 volts rather than 0-5, 0-1.5 or some other range. 0-1 volt was considered, but a ten-volt range seems to be more appropriate for meter calibration and general laboratory work.

Many applications for the Calibrator will demand so little current that its calibration will be inappreciably altered. To achieve a 1% change in calibration, the load must steal 1% of the 5 mA supplied to the multiturn pot. That is 50 microamps. If this current is supplied from 10 volts, the load is 200 k Ω . If the load exceeds 200 k Ω , no correction is required for most applications. For example, an 11-

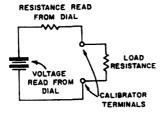


Fig. 8. Shorthand equivalent circuit for quickly estimating true voltage at the Calibrator terminals when supplying current to a substantial load.

megohm VTVM, a backbiased diode test, or a voltage comparison test in which two voltages are adjusted to equality so that no current flows, would require no correction at all.

But laboratory applications are so variable that no guarantee at all can be made as to the size of the load. The key to the problem of working out the calibration change under load rests in the constant current generator. It always supplies 5 mA, or something very close to it. The situation resolves to that shown in Fig. 7. The load current is subtracted from the constant 5 mA, the voltage across the Calibrator terminals must be that due to remaining current through the resistance from slider to ground. This resistance is two ohms per division, since the 2000 ohms of the pot are allocated equally to the 1000 scale points.

Fig. 8 shows an equivalent circuit which expresses the same facts. A generator always supplies the voltage seen on the Calibrator scale. The load current passing through R reduces the voltage to that seen at the output terminals. R is the resistance from slider to ground of the pot. The subject is more fully discussed under Thevinin Generators in many electronics texts: this concept is one of the greatest problem solvers going.

Some suggestions

It isn't necessary to build the Calibrator exactly as described. I've tried to describe it completely enough so you can see what the ideas behind it really are. You can work up your own model which might be very different from mine. Here are some of the variations which occur to me.

A single-turn pot might be used, preferably wire-wound, although 5 mA through 2 k Ω will dissipate only 50 milliwatts so that a composition pot could be used. But in such a case you probably cannot trust the linearity, which greatly simplified and improved my Calibrator. A resistor or a set of resistors could have been used, which would limit the number of voltages available, but would avoid the expense of a multiturn pot. The voltage out or the transistor current could have been chosen at other values, but there are problems here too. If a very low maximum voltage is chosen, you may find yourself involved with thermoelectric effects. If a high transistor current is chosen, you may find, for some applications, more drift than you like resulting from variation in transistor dissipation as the battery runs down. Well, have at it! Make up a breadboard and don't be afraid to try out some new ideas starting where I've finished.

The Link

Like to try a two meter yagi with a semi-cylindrical reflector?

If you are interested in making your "Five Watter" sound like a big rig, then read on.

The "Link" I am about to describe has been the volume producer here for sometime now and I feel that it warrants passing on to the brotherhood at large.

There is no great cost involved, in fact five dollars should cover the Link quite well.

The materials involved are a length of tubing for the boom (the boom from an old TV antenna works quite well) and a roll of aluminum clothes line wire for the elements. The rest of the hardware should be handy around the "shack."

The basic components of the design are by no means new, but putting them together in this configuration I feel is now or at least novel and for good measure it works.

The basic theory behind the antenna is a modified corner reflector used as a launching device for the yagi antenna. An added bonus is the unusual front-to-back ratio gained by this method.

It might be well to add here that if you are

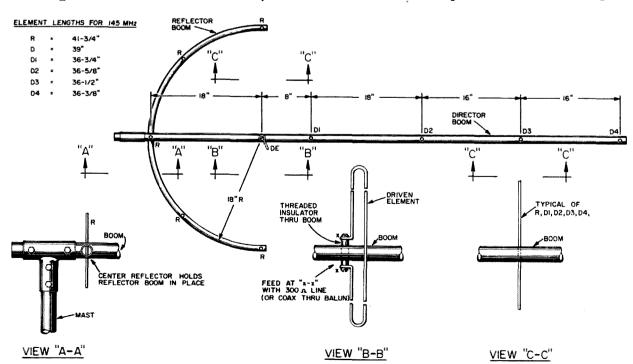
only interested in local rag-chewing in the big cities and don't care to rotate your antenna for each contact, forget it and go on to the next article. This antenna is for the stations that are hard to copy.

The method of mounting the antenna makes it quite adaptable to either horizontal or vertical polarization depending on the locality.

The method of construction should be quite clear from the diagrams, but there are a few things that are hard to show in a drawing such as the method of mounting the boom for the corner reflector part of the antenna.

The boom is first drilled to take the reflector boom. When this is in place then the hole for the reflector element is drilled through both pieces of material and the reflector element set in place. This will then hold the whole assembly ragid.

The next step is the driven element. A hole is drilled in the boom and an insulator that is about one inch longer than the boom is thick is inserted through the boom. This then becomes the anchor point for the folded dipole



driven element. The beam is also fed at this point, either through 300 ohm line or with a balun

As for tuning the antenna, well if the beam is constructed using the measurements given I think you will find little if anything gained by shifting the elements. A bit might be gained by clipping the elements for spot frequency operation, but that's up to you.

The tests given this antenna were with a fellow ham W6RGG across the valley from my location about four airline miles away.

The test equipment used for this evaluation? A "Gooney Bird" and a receiver with an S meter. The antenna was mounted on a thirty foot mast and pointed toward the receiving location, the rig was turned on and a steady tone was used for modulation.

The S meter at the receiving location was set for twenty over nine, then the antenna was rotated. The main front lobe seemed to be about thirty degrees wide. The side lobes showed a reading of S2 and the back was all but unreadable on the meter.

A word about the mounting feature. It may seem at first glance that the beam will be off balance, but in practice it has been found that with the beam so light and the advantage gained by this type of mounting there is nothing to fear.

I can only hope that those of you who construct this antenna get as much enjoyment out of it as I have had.

. . . W6HGX

William is a transmission man for the Pacific T and T Co. He enjoys VHF and UHF antenna design and construction and home building of equipment.

Stop Slipping Dial Drives

Does the cord and pulley dial drive system in your receiver slip occasionally? If so, here's a good emergency substitute for cake rosin or commercial non-slip compounds.

Place the tip of a hot soldering iron or gun on a clean area of the chassis and tilt the iron so that the tip forms a small angle with the chassis. Feed rosin-core solder into the gap. The cold metal of the chassis will conduct enough heat away from the molten solder so that the flux, instead of vaporizing, will form a "puddle" on the chassis. Remove the soldering iron, allow the flux to solidify and scrape it onto a clean piece of paper. Finally, crush the flakes of flux with a fingertip and rub the resulting powder onto the dial drive cord.

. . . Bradley Thompson

ROHN.

Asks...How do you rate a tower when the stories all sound the same?

There is a one-word answer — PERFORMANCE!

ROHN TOWER performance has made it the top name in the industry. Wherever you go worldwide - you find ROHN TOWERS — CATV, microwave, communications, broadcast, home TV and amateur — with complete accessories, lighting, microwave reflectors and equipment. ROHN TOWERS - the accepted standard - recognized as the towers that provide strength, durability, ruggedness, appearance, design, adaptability and prestige. ROHN popularity rests on these factors:

• Computer Analysis & Engineering Design • Manufacturing • Warehousing • Turnkey Tower Erection • Complete Lines of Accessories

Representation and Distribution Worldwide

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Some Techniques in Tone Signalling and Decoding

Tone signalling has many uses in ham radio, especially in VHF emergency and other nets. This article describes a few things that should be considered in using tones.

It is perhaps time to admit that the manufacturers of citizen's band equipment have in one respect gotten a bit ahead of amateur radio progress. Amateur RTTY operators have for sometime used various "auto start" systems to good advantage, but the typical amateur hasn't really put to much use any automated transmission start-stop system such as is presently employed by many CB two-way stations.

Naturally, in the course of everyday operation the typical ham doesn't have much need of the system described here, but increasingly more amateurs are going to remote operated equipment to obtain better advantage of physical surroundings. Although the authors cannot vouch for the legality° of operating such a system, it seems reasonable to assume that an amateur could operate his home station by remote signals from his mobile station. This would allow any non-amateur in the home to speak with the mobile station, since the home station would in effect be directly controlled by the mobile station and hence under the direct control of a licensed amateur. The pos-

o It is likely that the operation described might require a remote station authorization. Check before you try it,

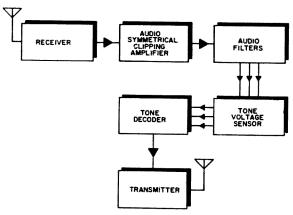


Fig. 1. Block diagram of a tone signalling repeater system.

sibilities of this situation seem very intriguing, particularly in the case of businessmen who must remain away from home for extended periods or at long distances. With the system to be described here, a particular sequence of tones modulating either an SSB or AM transmitter (either A3, A3a or A3j modulation) could be used to trip a receiver, turn on a second transmitter and then turn on or turn off either or both the receiver or transmitter in any prescribed sequence. Similarly a different sequence of the same tones, or different frequency tones, could be used to shift frequency, rotate the antenna or perform any number of functions at the receiving end. The possibilities are limited only by the desire and ingenuity of the operator.

System theory

The system block diagram (Fig. 1) shows the general configuration for the use of the sub-units to be described later. A signal coming in the antenna to a receiver preset to the desired operating frequency is passed onto an audio clipper and amplifier. The purpose of this first operation is to ensure that all the tone signals are of equal amplitude before reaching the audio filter. This not only relieves the filters of the requirement of undue selectivity but also ensures that the output from the audio filters is about the same for all tone channels.

The next block, the audio filters themselves consist of a number (depending upon the number of tone channels used) of simple L-C filters resonated to the frequency of the tone channels. In this article a three channel, and hence three filter, network is described, but again more or less channels and filters may be used depending upon the desired complexity of the end result. Obviously, there is one filter resonated to the tone frequency of each tone channel used.

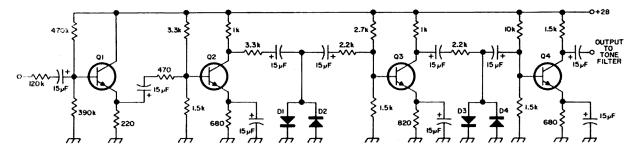


Fig. 2. Symmetrical clipping amplifier. See text for transistors and diodes.

Following the audio filters are the tone voltage sensors, one sensor for each filter, hence one sensor per tone channel. The function of the tone voltage sensors is to detect the audio tone when present at a filter output and convert the tone to a dc level appropriate for driving a switch. This is accomplished by a variable threshold gate and Schmidt trigger arrangement to be described later.

Dc voltages which correspond to the presence of a tone are passed on to a tone decoder which consists of nothing more than a series of relays interconnected in such a way that the sequence of tones received must be in a certain prescribed order before an output is obtained. Certainly more sophisticated electronic switches could have been used in this application, but for purposes of explanation the sequence of operations is perhaps most easily understood when presented in terms of relays. This also lends itself to direct junk-box production by the amateur in most cases.

Connection is shown from the tone decoder to a transmitter, but obviously the piece of gear being controlled might be anything the operator desires, multiple operations or multiple equipment functions can be controlled as pointed out previously.

General

Although each circuit to be described here is complete and correct, the intent is that the circuit function to be detailed is of more importance than the actual hardware of the circuit itself. Consequently, no direct examples are given for building duplicate units though duplicates may be constructed quite easily. Actually there is nothing the least bit critical about construction save that the usual precautions to prevent rf energy from entering the

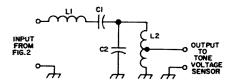


Fig. 3. Tone filter. L1-C1 and L2-C2 should be resonant at the desired audio frequency.

audio stages should be observed. As mentioned previously, the number and types of equipments controlled by this type system is practically unlimited dependent upon the resources of the individual amateur.

Audio symmetrical clipping amplifier

As explained, the purpose of this circuit is to provide a constant amplitude signal to the tone filter regardless of the audio output amplitude of the receiver at any given time. The input to the circuit is a sine wave at the audio frequency, and because of the particular design here, the output is very nearly a square wave of the same audio frequency. Looking at Fig. 2, it may be seen that the input stage is an emitter follower which is biased at about half the B+ voltage. This stage is used simply to provide a high input impedance as well as low output impedance to drive the second stage. This second stage is an amplifier driving a diode clipper. Since the voltage gain of this stage is high (about life x 1k) the sine wave at the collector is heavily clipped by the D1-D2 pair, then passed on to another amplifier and diode pair where the signal is again amplified and clipped. Notice that no type has been called out for in the diodes or transistors: any transistor with life greater than 100 at 1 kHz will surely do, and any good silicon diode will fill the bill. The one and only requirement that must be carefully met is to be sure that all stages are biased in the mid-range of their operating conditions. The "Q-point" must be

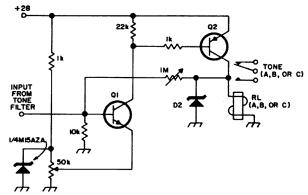


Fig. 4. Tone voltage sensor for use with a tone filter such as the one shown in Fig. 3.

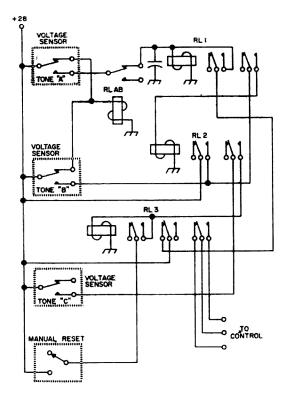


Fig. 5. Typical tone decoder. See text.

set mid-range between cutoff and saturation. This is because a large amplitude signal will cause the transistor to clip as well as the diodes, particularly at Q3 and Q4. Since a clearly symmetrical output is desired, the transistors must begin to "bottom out" and "topout" evenly for increasing input signal.

Tone filters

The tone filters are used to select and pass the individual audio tone frequencies desired. The filter shown in Fig. 3 is about the simplest that is useable. Normally the audio frequencies selected are about 1 kHz apart and thus this simple filter is more than adequate to reject adjacent tone "channels." Certainly a more complex multi-pole filter may be used and the separation between tone channels reduced accordingly, For this filter, L1-C1, and L2-C2 are resonated to the desired audio frequency. As can be seen, with reasonable (greater than 50) Q inductors a fairly high selectivity may be obtained. Ordinarily the output tap on L2 is about \(\frac{1}{2} \) of the coil up from the ground end. For fanatics there are a number of active filters which will provide as little as 1 Hz 3 dB bandwidth at 100 Hz center frequency. However, anyone sufficiently versed in the literature to use such a circuit is probably bored with this article and has quit reading, hence no further discourse is given here.

Tone voltage sensors

This circuit is essentially a variable threshold relay driver with a variable feedback circuit to provide high sensitivity and a certain amount of latching action. Again the active devices aren't specified since so long as good hefty (perhaps 1 watt) transistors with Vce of at least 30 volts are used no trouble will be experienced. Progressive shorting out of the one megohm pot will increase the sensitivity of action, but will also provide increasing hysteresis on signal release such that in the extreme, several volts differential would be apparent between the threshold level and the release level. The threshold level is preset by the 50 k Ω resistor in the emitter of Q1. This preset level is above the noise output level of the tone filter but generally below the maximum tone output amplitude. Notice that the relay is the same as that depicted in Fig. 5.

Decoder

The decoder of Fig. 5 is composed entirely of relays principally because relays are quite often available to the amateur in quantity. However it is obvious that a considerable reduction in size, weight, and generated transient noise could be obtained by use of equivalent solid state switches.

Obviously the simplest decoder would be a single switch which closed upon the presence of a given tone. However such a system would be vulnerable not only to accidental tripping and jamming, but also would be vulnerable to deliberate interference. The decoder shown here is fairly elaborate, but not so involved that construction is prohibitive. In many respects this decoder simulates the function of a "secure" system used by many governments to avoid unauthorized use of equipment and ensure secrecy.

For this particular decoder three tones of differing frequency are necessary (and hence three tone filters, etc.) for operation. The tone frequencies have been labelled A, B, and C for convenience; tone A might be selected as 1 kHz, tone B as 2.5 kHz and tone C as 5 kHz for instance. Due to the interconnection of relays and contacts a sequencing action must take place before the control is actuated. In this case, tone A must occur before tone B, and tone B occur before tone C, and A and B may not occur simultaneously. Hence, unless some random signal or person interested in actuating this system knew the exact tone frequencies and the proper sequence of these frequencies the control would not be actuated. Thus by using the latching properties of only four relays a very "secure" three tone system is available.

[•] For those who wish to pursue this phase of the project, a really excellent article entitled "Selective Audio Amplifiers" appeared in the July Electronics World.

Conclusions

The four basic building blocks described here constitute the prime requirements in a secure tone signalling system. The uses have been briefly described for tone systems, and if nothing else, it is quite apparent that a very good amateur remote control system could be effected in a variety of ways. Each building block is quite uncomplicated, and easy to build and adjust. The authors have implemented this system in a variety of ways, for single tone signalling using one to eighty meter remote to home applications, all with great success. As was stated before, the applications are limited only by the ingenuity of experimenter.

. . . WB6MOC, K6YTY

A Low Cost AC Regulator

The detrimental effect that line voltage changes have on oscillator stability is well known by most hams.

A low cost voltage regulator suitable for use with VFO's, frequency standards, and other equipment having small a.c. power requirements (approximately 20-30 watts) is shown in Fig. 1. This circuit is almost identical to the one suggested by Lamkin Laboratories for use with their MFM frequency meter. (Switch and fuse added.)

This circuit will reduce voltage variations to about one third; the output will be approximately 100 volts RMS. In addition to the improvement due to the regulated line voltage, the reduced results in less heat being produced in the oscillator. By using this circuit, the filaments are operated at a reduced, regulated voltage.

The regulator should not be placed near the oscillator circuit as it produces considerable heat. A separate chassis is suggested, and the switch in the load should be shorted as operating the regulator without a load can ruin the OC3's.

We have used this regulator with a MFM for almost a year with great success. The cost is low and the construction very simple; give it a try.

... Deap Cupp W4JKL

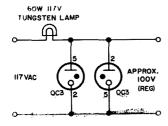
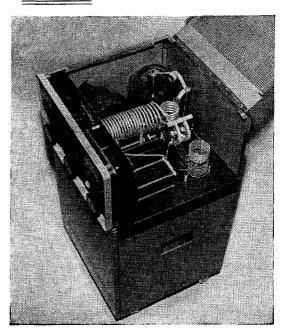


Fig. 1. A low cost AC regulator.

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The Vanguard 501 TV Camera

Talking to people over the radio is certainly one of the most intriguing hobbies that exists—as all 73 readers certainly know. But think how much more fascinating not only talking, but seeing, your contacts must be. Most hams have had at least some thoughts about ham television, but most have also never thought seriously about getting on TV because in the past, TV has been complex and costly, and TV signals have limited range and there have been few hams on amateur TV.

Well, TV signals still don't travel very far, but modern techniques of high power, high gain antennas and low noise converters have made reasonable distances possible. And more and more people are getting on TV. Transistors, varactors and modern transmitting tubes have made TV less complex than it once was, and the cost isn't unreasonable. It certainly can cost far less to put a TV station on the air than many hams spend on commercial sideband equipment. Obviously, TV isn't for all hams, but the experimenter can have plenty of fun with it. In large cities, for instance, licensing classes can be telecast to prospective hams, or technical sessions held for those wishing to increase their knowledge (or license class). The receiving converters for regular TV sets can be quite simple; see the article by PAØVDZ in this issue, for example. ATV'ers have telecast church and other events of interest to bed-ridden persons or others. I'm not sure where the FCC draws the line on broadcasting on ham TV, but there are obviously many possibilities for public service and good publicity for hamming with TV. Think of the fame you'd receive if you were to start the first (and only) TV station in a small town!

You can get on TV with a flying spot scanner, an obsolete converted surplus camera, or even a cast-off commercial camera, but there's no question that the most practical type of signal source is a modern, inexpensive vidicon camera designed for closed circuit TV such as the Vanguard model 501 camera. I've had the chance to play with one for some time now, and though I haven't put it on the air

yet—at least on a ham band—I've come to the inescapeable conclusion that I should. Let's take a look at the Vanguard 501 and see what it has to offer:

In the first place, the 501 is tiny. Until you see it, it's hard to believe how small it is. It's almost the same size as five small pocket books in a pile. The small size is a result of the complete transistorization of the circuit (except for the vidicon and neon bulb HV regulators) and the compact, modern, plug-in etched circuit board construction. The camera weighs only 3½ lbs., yet seems to be very sturdy and well-made.

The 501 uses twenty transistors, including a low-noise VHF field effect transistor input amplifier. A clever part of the circuit is that the vidicon is used as a light sensor to set the camera for best conditions with lighting changes. The power supplies are regulated.

Output is either standard 1.5 volt video for use with a video monitor, modified TV set, or TV modulator for a transmitter, or rf for direct feed to the antenna terminals of a TV set tuned to a low band channel. The video output gives better quality, but the rf output is obviously more convenient. There's certainly plenty of output: I used the camera with 250 feet of coax with no problems (except that we did get into the neighbor's set on a blank channel. Good for remote baby sitting, I guess.) In either case, the quality was excellent. Everybody in the neighborhood, and all of their children, had to look at themselves on TV, and though all of them thought their likenesses horrible, they also agreed that everyone else looked very natural and that the camera did a magnificent job.

The camera worked well with only normal room illumination, or in the bright sunlight. Even with a small bulb at night, you could get a pretty good picture. The lens is inexpensive. It's 8 mm rather than the more expensive 16 mm variety, so telephoto and other extra lenses could be added to the 501 without spending a lot of money.

The only trouble I had with the camera was erratic noise in the picture at first. This was apparently due to a bad ground, and was easily cured by tightening a fairly-obvious loose mounting screw.

No schematic or instruction manual comes with the camera, though Vanguard has reported that one will be made available in the future. The camera is guaranteed for a year except for open filament or breakage of the vidicon.

As you can tell, I'm real pleased with the 501 I have been using. It is certainly an excellent buy at \$279.95. . . . WA1CCH

The Shackcom

A simple intercom that can be built from junk-box parts.

For all those who have felt the need of a communication link between the shack and the household I have a solution. The Shackcom shown in Fig. 1 is a inexpensive, simple, and compact, two-way intercom. The circuit employs the three distinct types of transistor amplifiers and thus would serve as an excellent introduction to transistor circuits: T1 is in the common base configuration and thus transforms the 8 ohm speaker impedance to high impedance. T2 is in the common collector configuration and thus transforms the high Z output of T1 to about 400 ohms with a power gain. T3 is in the common emitter configuration and thus raises the 400 ohm output of T2 to a slightly higher impedance with a large gain in power. T4 and T5 are also in the common emitter configuration and develop the power needed to drive the second speaker.

Nothing about the circuit is critical. The output transformer T as well as the transistors T4 and T5 were taken from a discarded transistor pocket radio. The electrolytics can be of any value in the microfarads. The speakers used should be of the 8 ohm type, ½ watt, and with at most 5 inch cones. The volume control R is not necessary since the maximum output of the Shackcom is not excessive as long as the person speaking is at an arm's length from the speaker cone. The 2N404s are sold for ten per \$1.00 by Poly Paks.

The prototype of the Shackcom was built on a 2" x 7" circuit board, and mounted in a 3" x 5" x 7" box with a 4" cone speaker. The circuit 1 is drawn in such a way to suggest how the Shackcom could be laid out on a printed circuit board.

. . . W8MQW

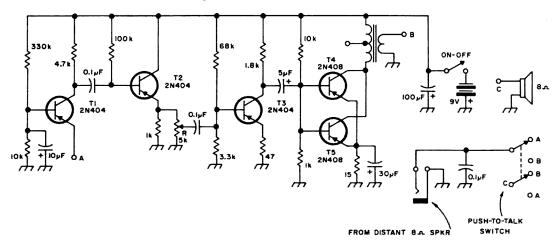


Fig. 1. The Shackcom—a simple transistorized intercom. Three types of amplifiers are used: common base (T1), common collector (T2) and common emitter (T3 and T4 and T5).

Butch Plugs

When you're working on a chassis or panel and make a butch by drilling or punching a hole in the wrong place, sometimes it can be a problem. For the larger size holes (about ¼ inch and above), you can buy a hole plug from one of several manufacturers. How about small drill holes? Very simple, mix up a batch

of epoxy adhesive and fill the hole up. Make sure there is a little additional material above the surface of the panel. When the epoxy hardens, it tends to shrink slightly, and if sufficient material is not left on the surface, a small indentation will result. After the epoxy hardens, sand it smooth. A little paint and nobody will ever know that you drilled a hole in the wrong place.

. . . Jim Fisk W1DTY

Gus: Part 19

After a very FB stay at Diego Garcia Island we all boarded the ship and took off for Salomon Island, another in the Chagos Archipelago. This island is some 50 to 75 miles away from Diego Garcia. We were met there by the manager of Salomon Island and invited to have supper at his house. He had his wife with him, a very charming person whose hobby is painting. She had a very large assortment of paintings of the islands, some of which would have won honors at any artists' showing. Believe it or not, they actually had a Coca Cola-they had had it for about ten years, I think. When it was opened it did not even go plop; it was completely flat. In South Carolina I would be afraid to give it to my dog for fear the dog would turn up his nose at it. But on Salomon Island that one Coke tasted like something direct from Heaven. We were served a very elegant meal, prepared undr the directions of the manager's French wife. Of course they had many different kinds of wine-what Frenchman does not? Late that night we went back to our ship. I did a little operating /MM for a few hours.

Early the next morning we loaded up the copra there and about noon we lifted anchor and were away for VO9, Mahé. This return trip was a real dream ride: all the way "down wind." Hour after hour I would lie back in a deck chair watching the flying fish. They would all take off like a covey of partridges and sail through the air for a hundred feet or so. These Indian Ocean flying fish actually get about 20 feet above the water and sail with the breeze just like a bird. It's a beautiful sight to behold; they are a bright silver and actually shine in the sunlight. At night I used to like to watch all the apparent fireworks down around the propeller if the engine was running, or just at the point where the water passed the rear sides of the boat if it was under sail. They tell me it's some kind of algae in the water. How this stuff can look like fire when it's submerged I don't quite understand, but there it was every night. Looking south at night I could just see the Southern Cross on the horizon, not almost overhead as on Bouvet Island way down South, and not almost overhead as the North Star is when in the Faroes. There was always a nice cool breeze on the ship's decks and this trip back was about the nicest one I have ever had on any boat anywhere. We were out of the monsoon belt on this trip and this made the trip a real smooth one.

Upon arriving back at Mahé and paying for my trip to the Chagos, away I went again to my little "Hotel de Seychelles" where it was costing me \$22.00 per week for room and board. When I was there they had no electricity at the hotel except their dc current which was no help to me at all. So it was connect up my little putt-putt again and buy some gasoline (they call it petrol) for something like 80¢ per gallon. The hotel there now has ac current from Port Victoria, I understand. That's the hotel that has thatched huts for each hotel room, all in a long row up and down the beach. They always gave me the one on the end so that my putt-putt would not keep everyone awake all night when I was on the air. Incidentally the food there is very FB: plenty of breadfruit, pineapples, oranges, coconuts, lemonade, fish cooked every way possible, turtle meat quite often, swell pastry, plenty of good home cooked cake, and even once or twice per week they have ice cream. All this for \$22.00 per week. Not bad, eh? I again headed down to the dock area every time I had the chance. I had shipped there 3 forty meter AM phone rigs with the right model ARC receivers to tune 40. They wanted one installed at the owner's home on Mahé. one at his son's home on Mahé and the other down on Aldabra Island. Aldabra has no radio link with the outside world at all; all they have is a transistor radio to listen to the BBC and get the news.

Another boat was soon taking off for Aldabra Island, going via Cosmoledo and Assumption Islands. They decided to have the unit installed on Assumption Island instead of Aldabra since they were planning on cultivating guano on Assumption shortly. They told me to be ready to leave in two days.

If you want to see a new way to install a 70-foot bamboo pole get these Seychelles fellows to do the job. Here is how they put one up for me: they dug a nice hole (with their knives) right below the point where there were two big limbs on a tree that looked like an oak. One fellow got up in the tree with a piece of rope. They then put the small end of the bamboo at the edge of this hole they had dug and tied the rope to the small end of the bamboo. Then the other ten fellows started pushing the large end of the bamboo towards the hole while the fellow up the tree pulled up the small end. The large end was eventually dropped into the hole. I tried explaining that there were better ways to do this job, but none of them spoke English. I learned that there are many ways to do a simple job, many of them different from the way we have always done it back in the States. It makes you want to pull out your hair (and I ain't got much to pull!).

This ship that was going to Aldabra was going mostly to haul back a load of those very large turtles. The stop at Assumption was to bring back its manager, and to also install the 40 meter AM rig there. This was a fairly good sized ship (about 3 times as large as Harvey's-VQ9HB). The captain was a 100% full blooded Seychelles captain, tough as nails, with a good loud voice that his crew could hear even in the middle of the monsoon. He was the boss on that ship; when he spoke, they jumped. To me he was as kind as a father, so I have no complaints. Down to the ship I went and loaded everything on board. putting my /MM rig right up in the poop deck beside the big wheel. I mounted my putt-putt this time way up on top of the crew's sleeping quarters roof, because the S.E. monsoon was at its peak now and we all knew we were heading right into its teeth. I wanted to keep the water from getting into my putt-putt. Even up there it did get soaked by some of those monstrous waves. Those waves were killers down around the Aldabra area, and Aldabra is partly shielded by northern Madagascar.

As I said, we left VQ9 and headed for VQ9C (Cosmoledo group) making a very short 2-day stop there to pick up some copra and dried fish and deliver the usual mail and some much needed supplies. Then we were on our way to Assumption Island, right down in what Harvey calls the Cyclone Belt. We did really get a full dose of winds, rain and I don't know how high the waves were, but to me they looked like mountains falling down on the ship. We were tossed every which way and it was a battle staying in our bunks even

with their side-boards up. Sea sick-don't make me laugh. Those fellows on that ship did not know what that word even meant. As for me—I had a long time ago found how to control those butterflies in my stomach. Just tell yourself that you are not going to get sea sick, make yourself believe it and you have it made. So there was no sea sickness even with the tossing ship all the way, every minute of every day. It never did come up for a breather as it does sometimes during the year. I had installed my rig up in the poop deck and we were up about 40 feet, where every roll and rock of the boat was multiplied by about 5. To sit fastened down at my operating position I soon learned to get in swing with the ship. I became a part of the boat; when it rocked, I rocked along with it. I told someone over the air I had the Aldabra Swing while I was on /MM, and I really meant it. This was exactly the opposite of the return trip from the Chagoes with that nice steady breeze blowing up back of us, pushing us along at a very steady rate.

After about 6 days we sighted Assumption Island. We anchored off shore about one-half mile down wind from the island. The island shielded us pretty well from the high seas. I loaded up everything and went ashore in the first landing boat. While they unloaded some lumber, doors, windows, etc. to build some small houses, I did some operating. I also mounted the wind-driven battery charger and two large 12-volt batteries, the ARC-5 being 24 volt operated. I got the wind-charger in operation and explained to the island manager that they should charge one battery one day and the next one the next day (the wind charger was only for 12 volts). He said he understood me (which I still have my doubts about). The modulation of this AM phone rig was way down and I was not satisfied with it at all but we had to leave the island the next day. A hint to anyone taking equipment to out-of-the-way places: test and test your equipment over and over and make sure that it's really on the ball before you ever leave the USA. You cannot ever be too careful, because out on some remote island there is no radio supply house around the corner. You cannot even find one bolt or nut on these islands. You bring along everything you need, or you do without and patch up the best you can.

We departed from Assumption Island for Aldabra Island, the distance between them being something like 50 miles. Incidentally, any of you who worked me while 1 was on Assumption Island don't have a new one; it counts the same as Aldabra since it's actually

in the same group. The high seas were still pounding away when we left and the going was pretty rough until we anchored sort of behind and in the shadow of Aldabra. Ashore we all went, the usual mail was delivered, up went my antennas again and I was on from Aldabra for the second time. The pile up was not as big as before but it was still there. To me it was always interesting to tune across a band that's very quiet and practically no one is on. You think everyone is off the air and that you have wasted your time going to that spot. Then you call that first CO; back comes mavbe one station. You exchange reports with him and stand by. Then maybe 2 or 3 stations call and you come back to one of them. On about the third QSO there are maybe 25 stations calling you. From then on the pile-up pyramids. It's up to you to work that pile down faster than they pileup! You keep saying dwn 5 or up 5 every now and then; even doing this the "lids" still keep calling you on your frequency. I have heard a number of stations that insisted on calling on my frequency, hour after hour, and day after day. They never get a QSO because it has always been my policy to never work anyone on my frequency. You newcomers to this game of DXing, take a hint from someone who has been in on the pile up from both ends. Listen to what the DX station tells you to do and do it. Try and find a station he works, listen to this station's speed and style of operation and try your best to imitate this fellow. Observe the frequency of the fellows he is working, try to figure out how the DX station is tuning, try to outguess the other fellows in the pile. Maybe do what Frank, W5VA, does; watch for that peak signal condition and "nail the DX station" at that moment. That's the way to get that S-9. . . .

. . . Gus

Storing Test Leads

If your workshop is like most, your clip leads and test prods are always scattered all over the bench; and when you do pick them up, there is no convenient place to store them. A neat solution to this storage problem is to install two screw eyes in the wall about 30 inches apart; a piece of soft iron mechanics' wire is then strung horizontally between them and connected securely at the ends. To store leads with alligator clips, simply clip one end of the test lead to the storage wire and let the other end hang free. To store leads without alligator clips, just loop them over the wire. With this method of storage your test leads are always where you can find them.

. . . Jim Fisk W1DTY

HERE IT IS!



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A Little About Noise

Perhaps more than a little; Bob's treatment of this important, but little understood subject is careful and complete.

Noise. This word describes the natural phenomenon which establishes the limiting range of all communication systems. To the DX man noise is the reason he can't work ZS1 at noon on 80 meters. Sure, a little of his signal reaches ZS land, but it is so far under the noise that it is useless and undetectable. To the VHF man noise is what stops him from working KL7 on 432 MHz. Again, some signal might get to Alaska by various means, but its very weakness, compared to the noise level at the receiving location, defies reception. Noise even affects the 75 meter ragchewer when a nearby electric shaver or ignition system tears up the signal he's listening to.

Now since noise has so much to do with establishing the limits of our ability to communicate, it seems wise to reach an understanding of what noise is, and how we might cope with it. And that brings us to the purpose of this article. If you stick with us from start to finish you will emerge with some basic knowledge of noise in radio systems. You will have an understanding of what noise is, what

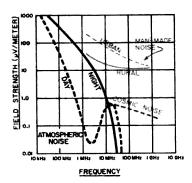


Fig. 1. Showing how the intensity of various types of noise sources varies with frequency. Source of graph: Reference 5.

causes it, and how to eliminate a good part of it from your receiving system. Further, such vague subjects as "equivalent noise temperature," "noise figure," and "minimum discernible signal strength" will be explained. But enough of this introduction, let's get into the meat of the subject.

What is noise?

Before discussing any technical subject it is always a good idea to define the terms to be used; then it is clear just what is being talked about. So, just what is noise, how can we define it?

In the most general sense, noise is any signal at the output of your receiver other than the one you want to hear. Therefore, noise is the hum and hiss, the static crashes, the ignition pulses, and the kilowatt tuning up 200 hertz from the signal you're tuning. The latter is more properly termed an "interfering signal", though, and we won't class it as noise. This article will treat all the others, as noise. Let's look at some specific noise types.

Cosmic noise. This is noise radiation that originates outside our atmosphere. It may come from the sun, our own galaxy (the Milky Way), from other galaxies or from some discrete "radio stars" which have been discovered. A great deal of it does indeed originate at the sun. The level of this "solar radiation" or "solar noise" varies from low "quiet sun" levels to magnitudes which are as much as 50 dB greater during "disturbed sun" periods. Sometimes solar radiation is even responsible for periods of radio blackout.

Most people have seen the band of stars in the sky known as the "Milky Way". These



Fig. 2. Noise equivalent circuit for an electrical conductor or resistor.

are mainly the stars of the galaxy of which our own sun and planet are members. Our galaxy takes the general shape of a saucer and since we are on the saucer, the rest of the galaxy appears as a band of stars when we look in the right direction. If we point a high gain VHF antenna at this band we will observe that the receiver output noise level increases. In particular, if we point it at the center of the galaxy, where the concentration of stars is greatest, we will note a 10 to 20 dB noise increase over other directions on the "galactic plane". All these stars are generating noise in a manner similar to our own sun, which is itself a star. There are some particularly noisy stars which have been recently discovered and these are among the ones called radio stars".

Altogether cosmic noise is believed due to the "black body" or thermal noise (explained below) radiation of the interstellar bodies. It is not particularly strong except in the region 10 to 300 megahertz where it is sometimes the chief contributor of noise to the radio system, and thereby establishes the smallest signal that can be detected. The intensity of cosmic noise decreases as the frequency is raised.

It should be mentioned that cosmic noise does have one good side—it is providing the signals which radio astronomers are studying to help us learn more about the nature of our universe.

Atmospheric noise. As hard to believe as it may seem to be, there is an average of about 2000 thunderstorms going on all the time at various points on the earth. Each of the thunderstorms produces lightning discharges, and there is an average of about 100 of these occurring every second. A lightning stroke is very similar to an electric arc, or spark, and generates a considerable amount of radio noise over a wide frequency range. This is the chief generation mechanism for atmospheric noise.

Now the generated noise is propagated for long distances, particularly in our DX bands, just as are the signals from our transmitters. Consequently, noise that originally came from a lightning stroke over Moscow may interfere with your QSO with a VK2 on 20 meters. In fact the intensity of atmospheric noise is dependent on time of day, season of the year, frequency of operation, weather and geograph-

ical location of the receiver. As a general rule, atmospheric noise decreases with increasing frequency, although there is an exception to this rule, as seen in Fig. 1. Also, the intensity decreases with increasing latitude of the receiving location. The thunderstorm seasons of equatorial Africa, the Caribbean, northern India, and other areas along the equator, make these locations particularly noisy.

Another source of atmospheric noise is "black body" radiation by the atmosphere itself. This is usually not particularly important today, but within a few years as more amateurs use the UHF bands we will have to learn to combat its effects, since it increases at frequencies above 1000 MHz.

Fig. 1 shows that atmospheric noise ceases to be a prime noise source above 50 MHz. This is due to the loss of long-distance signal propagation at the higher frequencies. Below 30 MHz, however, we do have to concern ourselves with limiting the effects of this noise as much as possible. Some means of achieving this are the use of high transmitter power, receiver bandwidth no wider than the signal received, peak-limiting or noise-silencing devices for high amplitude, short duration pulses from nearby lightning flashes, and the use of high gain receiving and transmitting antennas. And of course these means are generally useful for combating the effects of other types of noise as well.

Man-made noise. In the frequency range from 1 to 500 MHz there is considerable noise radiated by the machines man creates to do his work for him. A classic example of this type of noise is the impulsive signal emanated by the ignition system of an automobile. As with lightning, the generation mechanism is an arc, this time at the spark plugs. Anyone who has had an unsuppressed automobile pull up next to his receiving antenna knows what this type of noise can do to even a strong signal. Noise-blanking devices are usually about the most effective in eliminating this type of noise. Also, since man-made noise is generally vertically polarized, maximum utilization of horizontal antennas should be employed in areas highly populated by automobiles and other noise-generating machinery.

Other sources of man-made noise are power-line leakage, electric motors, and industrial heating generators. Noise from these devices can be so severe as to interrupt even commercial communication and broadcasting. At least one space shot from Cape Kennedy is believed to have aborted due to an interfering signal from some man-made source. Since man-made noise is mainly due to ma-

chines, it is usually higher in intensity in the city than out in the country. See Fig. 1.

Thermal noise

We now come to the single most important source of noise. Thermal noise is important not only because it is present in radio systems, but also because it is useful in theoretical developments to represent other types of noise by an equivalent amount of thermal noise. Consequently, a good understanding of thermal noise is absolutely essential to anyone who wishes to understand noise theory as applied to radio.

Just as total darkness is the absence of all light, so absolute zero is the temperature when all heat is absent. There is a temperature scale with absolute zero as its zero point. This is the Kelvin system. Zero degrees Kelvin is absolute zero, 273 degrees Kelvin is the freezing point of water and 373 degrees Kelvin its boiling point. Kelvin system temperature can be found from Centigrade (Celsius) system temperature by:

(1) Degrees Kelvin = Degrees Centigrade + 273

Now let's look at a conductor of electricity. Since there is no perfect conductor, it will have some resistance, and therefore we can treat it as though it were a resistor. Now if the resistor is sitting in a room, its temperature is probably about 290 degrees K. Under this condition the electrons in the resistor will be moving about in a random fashion. This random motion of the electrons creates a random voltage across the terminals of the resistor. By random we mean that we cannot predict what the voltage will be at a certain time in the future. However, we can state what the mean voltage will be, thanks to a man named Nyquist. The formula that he developed is this:

$$v_{n} = \sqrt{4kTBR}$$

 v_n = Mean noise voltage, volts

R = resistance, ohms

k = Boltzman's constant,

= 1.37×10^{-23} joules/degree K

T = Temperature, degrees K

B = Bandwidth, cps

Here the word "mean" is similar to "average", but a strict definition can be found in the textbooks referenced. Notice that the mean voltage is dependent on the bandwidth across which it is measured. This implies that the noise is evenly distributed across all frequencies, and this is truly the case, at least in theory. Noise that is distributed in this fashion is termed "white noise". We can now draw

the noise equivalent circuit for an electrical conductor, or resistor. See Fig. 2.

The next question that we might ask is, what is the noise voltage if I have two or more resistors in series or parallel? It can be shown mathematically that Fig. 2. can still used. First you find the effective resistance of the combination, this is then R. Then v_n is found from this R, by using Equation (2). Consequently, it is pretty simple to find the noise equivalent circuit for most resistive networks.

There is one more thing to be looked into about this noise voltage. Since its magnitude is random with respect to time, we cannot add two such voltages together directly (when they are in series) as we can with ordinary voltages. Voltage sources that cannot be added directly are termed "incoherent", and must be added by this formula:

(3)
$$v_{nT} = \sqrt{v_{n1}^2 + v_{n2}^2}$$

 $\begin{array}{l} v_{nT} = \ total \ effective \ mean \ noise \ voltage. \\ v_{n1}, \ v_{n2} = \ individual \ mean \ noise \ voltages \\ to \ be \ added. \end{array}$

This equation is illustrated in Fig. 3. Note that we will get the same v_{nT} whether we first combine the R_1 and R_2 and find v_{nT} directly from Equation (2), as in the last paragraph, or if we go to the trouble of using Equation (3). We are merely taking either of two routes to get the same result. However, both methods should be understood. Also, Equation (3) is not limited to the addition of just two incoherent sources. It can be extended to include as many voltages as must be combined. Thus for 5 incoherent sources:

(4)
$$v_{nT} = \sqrt{v_{n1}^2 + v_{n2}^2 + v_{n3}^2 + v_{n4} + v_{n5}^2}$$

where the notation is the same as in Equation (3).

Now we must find how much noise power is available from the circuit of Fig. 2. Most amateurs will tell you that you will draw the most power from a circuit like Fig. 2. when you load it with another resistance equal to R, and this is true. The new circuit is Fig. 4.

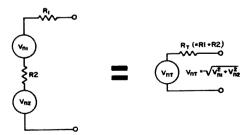


Fig. 3. Combining two resistors into their total equivalent noise circuit.

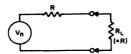


Fig. 4. Loading the circuit of Fig. 2 to obtain maximum available output noise power.

The voltage across R_L is $\frac{1}{2}v_n$, thus the power dissipated in R_L is (from Ohm's law):

(5)
$$P = \frac{E^2}{R} = (\frac{1}{2}v_n)^2/R_L = \frac{v_n^2}{4R_L}.$$

But since $R_L = R$:

$$P = \frac{v_n^2}{4R},$$

and from Equation (2) $v_n^2 = 4kTBR$. Thus,

(7)
$$P = \frac{4kTBR}{4R} = kTB.$$

Thus the maximum available output noise power is kTB. Note that it doesn't depend on what value R has. Therefore any conductor or resistor has the same available noise power at its terminals. This is a very significant fact and helps to simplify noise theory, as we shall see.

As noted above thermal noise is often used to represent other types of noise. This is because thermal noise is easily represented and worked with mathematically, while other types of noise often are not. Consequently, if we have a certain amount of noise power available from some source we can, by using Equation (7), represent that source by a resistor at the temperature T which gives the same available noise power output. (The bandwidth, B, over which we measure the available noise power must be the same for the source and our representation, of course.) Thus any noise source has an equivalent thermal noise temperature, or just "noise temperature". This is a very important fact to understand. For example, as noted above, the noise temperature of a star is roughly its actual temperature, because its output is mainly thermal noise.

We can now leave thermal noise for awhile and turn to another subject. If you feel a little hazy on some of the points covered above, refer to one or more of the references listed in the bibliography for extra instruction, or to get another viewpoint.

Noise in receivers

Up to this point we have mainly concerned ourselves with noise generated outside the receiver-antenna system. The only exception to this has been thermal noise, which is generated both within and without the receiving system. We now must concern ourselves with noise generated within the receiver itself.

Noise is generated in a receiver in several different ways. There is thermal noise due to the resistive elements in the receiver circuitry, and there is noise somewhat like thermal noise that is caused by the vacuum tubes and semiconductors in the receiver. These foregoing types of noise can be minimized by designing the receiver for low noise figure. Unfortunately, there are three other noise generation mechanisms within the receiver that cannot be minimized by design for low noise figure.

Cross-modulation. There are two ways in which two or more signals can mix together within a receiver to produce a third signal, which interferes with the desired signal. One of these ways is through cross-modulation. Cross-modulation requires the presence of only the desired carrier and another undesired carrier which is modulated. In cross-modulation the modulation on the undesired carrier appears on the desired carrier, that is, the modulation "crosses" over from the undesired to the desired carrier. The effect is due to limited dynamic range in the receiver. The undesired carrier does not necessarily have to be within the if passband of the receiver, and more often is not. The cross-modulation effect usually takes place in the stages of the receiver close to the antenna. The stronger the undesired signal, the more likely the effect is to be noticed. Low cross-modulation requires special design effort and designing a receiver for lowest possible noise figure will usually cross-modulation characteristic make the

Intermodulation distortion. This is the other way in which signals may mix in a receiver to produce a third, interfering, signal. Again it is due to limited linear dynamic range in the receiver. Intermodulation does not require the presence of the desired signal. It is the mixing of two undesired signals, or their harmonics (which are themselves generated within the receiver), to produce a third signal at or near the desired signal frequency. Again, this type of noise generation requires special design effort for its minimization, and a low noise

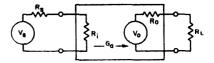


Fig. 5. Representation of an amplifier circuit. G_{τ} is voltage gain, v_{\circ}/v_{s} . G_{a} is available power gain.

figure design scheme will make it worse.

Noise modulation. This effect is merely a combination of cross-modulation and intermodulation distortion. Once again it is due to receiver non-linearity. Since noise is always present in the receiver, there is always a source of "signals" to produce the cross- and intermodulation effects. As a consequence there is always modulation of the desired and undersired signals by the noise in the receiver. If it were not for noise modulation, you would not notice any difference in output when tuning across an unmodulated carrier with an AM receiver. This is because the detector only responds to the modulation on the carrier, not the carrier itself. But since the noise modulation effect modulates the carrier with noise, you get the characteristic hissy noise output. Reduction of cross- and intermodulation effects will reduce noise modulation also.

Now we have an idea of some receiver noise problems. We will discuss them some more, but now it is time to turn to another topic.

What is power gain?

If you ask a typical amateur what the power gain of an amplifier is, he will probably tell you it is the output power divided by the input power. In a sense he is right, but there is a bit more to it than that. An understanding of that "bit more" is necessary to those who would understand noise theory.

Have a look at Fig. 5. (We will consider all impedances to be purely resistive.) Here we have a source of input power, made up of $V_{\rm s}$ and $R_{\rm s}$, which we will amplify with the amplifier in the box. The amplifier has an input impedance $R_{\rm p}$, and an output impedance $R_{\rm p}$. The load is $R_{\rm l}$. Now we can define several different power gains. The first we shall call just plain "power gain". It is defined thusly

(8) power gain = G_p

 $= \frac{\text{power going into } R_1}{\text{power going into amplifier from source}}$

Of course "power going into R_i" is the same as amplifier output power.

Now the real purpose of a power amplifier is to increase the power available from a source. But "power gain", as defined above, doesn't tell you whether the amplifier is actually achieving this or not. For example, if R_s and R_j are widely different very little power will get into the amplifier to be amplified and even with a large power gain the output power that is available from the amplifier may be very small, maybe even less than the source

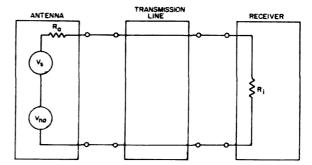


Fig. 6. The receiving system.

had available to begin with without the amplifier. In this case the amplifier would be doing more harm than good, for it is adding noise to the system, without increasing the available signal power. Consequently a better measure of amplifier gain is needed. This is called "available power gain":

(9) available power gain = Ga

 $= \frac{\text{power available at output of amplifier}}{\text{power available from source}}.$

The power available from the source is (remember how we got Equation (7)?): $v_s^4/4R_s$. And the power available at the output of the amplifier is: $v_o^2/4R_o$. Therefore:

(10)
$$G_a = \frac{V_o^2/4R_o}{V_s^2/4R_s} = G_v^2 \frac{R_s}{R_o}.$$

 G_a will be maximized when the input is matched, that is $R_j = R_s$, but is unaffected by the match between R_o and R_j .

We shall make considerable use of this available power gain in the development of noise figure theory. But while we're about it we may as well define two other types of power gain, which you will see more and more frequently nowadays and may not otherwise understand. The first of these is "transducer power gain". It is defined thusly:

(11) transducer power gain = G_t

 $= \frac{\text{power going into } R_l}{\text{power available from source}}$

Maximizing G_t requires matching both R_j to R_s , and R_l to R_o . A little thought will show that G_t is always less than or equal to G_a . In other words, G_t for a particular amplifier will never exceed its G_a .

The other frequently used gain figure is "insertion power gain". It presupposes that source and load impedances have been specified, and is a measure of the effectiveness of "inserting" a particular amplifier between the given source and load.

(12) insertion power gain

 $= \frac{\text{load power with amplifier}}{\text{load power without amplifier}}.$

The receiver-antenna system

We now have enough preparation behind us to begin a discussion of the receiving system. This system is composed of the antenna, the receiver, and the transmission line connecting the two. Fig. 6 is a representation of the system.

The transmission line will have a certain amount of loss, of course. We can look at this another way, though. Since part of the signal is lost due to the attenuation of the transmission line, there is less signal power available at its output than at its input. Therefore, the line has an available power gain of less than one. It turns out that the available power gain of the transmission line is equal to the inverse of its loss:

(13)
$$G_{aTL} = \frac{1}{L_{TL}}.$$

(Subscript TL means transmission line)

For example, if the loss is 2 (that is, 3 dB), the available power gain is ½ (or -3 dB).

Note that the antenna is represented by a resistance (we are assuming the antenna to be lossless and resonant) and 2 voltage sources connected in series. Let's look at each of these components one by one.

R_a is merely the radiation resistance of the antenna. This is the resistance that would be measured by an ohmmeter looking into the antenna terminals. Don't try it with your VOM, though, because the ohmmeter must operate at the resonant frequency of the antenna.

v_s represents the signal voltage. The antenna is immersed in an electromagnetic field generated by the transmitter we want to listen to, and the result has been the conversion of the field strength into the voltage, v_s.

 v_{na} represents the noise voltage. Part of this noise voltage is due to the thermal noise generated in R_a . The rest of the noise voltage is due to atmospheric, cosmic, man-made and other types of noise. This we term "excess noise", because it is excess to the inherent thermal noise in the antenna.

The antenna's actual temperature we shall call T_{ao} . Therefore the thermal part of the noise voltage is

$$\sqrt{4kT_{no}BR_{n}}$$
.

But remember we said awhile back we can

represent any noise by an equivalent amount of thermal noise, merely by raising the temperature of the representative resistor to the proper value. This is what we are going to do in the antenna. The total effective antenna noise temperature we shall call T_{aeff}. Therefore:

(14)
$$v_{ns} = \sqrt{4kT_{a,eff}BR_a}.$$

 $T_{a,eff}$ is the sum of the actual antenna temperature, T_{ao} , and an excess temperature, $T_{a,ex}$, which represents all the noise except thermal noise:

$$T_{a,eff} = T_{ao} + T_{a,ex}.$$

If there were no noise except thermal noise in R_a , then $T_{aveff} = T_{ao}$, of course.

in R_a , then $T_{a \cdot eff} \equiv T_{ao}$, of course. Fig. 7. shows how the excess noise varies with respect to frequency. Note that above about 700 MHz the excess noise has about disappeared, so that $T_{a \cdot eff} \equiv T_{ao}$, or in other words, $(T_{a \cdot eff}/T_{ao}) \equiv 1$. But below 700 MHz the excess noise gets larger and by the time we reach the 10 meter band (28 MHz) the excess noise is at least 100 times greater than the thermal noise. This great variation of the excess noise makes it necessary for us to divide our approach into two different parts. First we shall neglect the excess noise and look at the receiving system without it. Then we will put it back in to the system and see what changes we have to make to our thinking.

Noise figure

From Fig. 6 we can see that the antenna output contains noise as well as signal. With a given antenna there is little that can be done about this antenna noise, we just have to live with it. It would be nice though, if we could avoid having any additional noise added into the receiving system by the receiver. Unfortunately this is impossible, and the receiver does add some more noise. The receiver's noise figure is a measure of the additional noise contributed by the receiver.

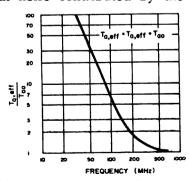


Fig. 7. Showing how $T_{a, eff}$ typically varies with respect to T_{ae} .

(This neglects any cross- or intermodulation effects in the receiver.)

The noise figure of a well designed receiver will be determined primarily by the "front end", that is, the stage or two closest to the antenna. Noise figure for an amplifier is defined thusly:

(16) noise figure =
$$NF = \frac{S_i/N_i}{S_o/N_o}$$
.

where: S_i = available signal input power S_o = available signal output power N_i = available noise input power N_o = available noise output power

This is merely the ratio of the input signal-to-noise ratio to the output signal-to-noise ratio. A perfect receiver would have a NF of 1 (or O dB).

Now we have the definition out of the way, let's see what we can do with it to find the receiver noise figure. First, if the transmission line is matched to the antenna and receiver input then the resistance seen by the receiver looking at the antenna is R_a. In this case S_i is the available power from the antenna multiplied by the available power gain of the transmission line:

$$S_i = \frac{v_{s}^2}{4R_a} \ G_{TL}.$$

The amplifier (receiver) available output is S_i multiplied by the available power gain of the amplifier (receiver): $S_o = S_i G_{aR}$. (G_{aR} is the amplifier, or receiver, available power gain.) The available input noise power is (neglecting antenna excess noise for now): $N_i = kT_{ao}B$. And the available output noise power is: $kT_{ao}BG_{aR} + \Delta N$. ΔN is the available output noise generated within the amplifier (receiver).

Now if we put all these quantities into Equation (16) we come up with:

(17) NF =
$$\frac{kT_{ao}BG_{aR} + \Delta N}{kT_{ao}BG_{aR}} = 1 + \frac{\Delta N}{kT_{ao}BG_{aR}}.$$

Notice that we would only have a noise figure of 1 if $\triangle N$ were O, which require a perfectly noise-free receiver.

Now take another look at Equation (17). Note that the receiver noise figure is dependent on the source temperature, T_{ao} . In order to avoid confusion, the radio and communications industry has decided that noise figure will be measured at $T_{ao}=290$ degrees K. If it were not for this standardization noise figures published by one manufacturer would be difficult to compare with those published

by another. Remember, noise figure depends on source temperature.

Receiver noise temperature

Often nowadays you will see the noise performance of a receiver (particularly the very low noise variety in the VHF and UHF range) specified in "receiver noise temperature." You may have asked yourself, what does this mean? How can I relate this noise temperature to noise figure which I understand better? Well, let's see.

Once again remember that noise is often represented by an equivalent amount of thermal noise. What we are doing with our receiver is pretending that the additional noise, ΔN , comes from a source at the receiver input terminals. This source must be at a temperature, $T_{R,eff}$, to account in a thermal way for the additional receiver noise. Therefore, $\Delta N = kT_{R,eff}BG_{aR}$. Now putting this into Equation (17):

$$(18) \quad \mathrm{NF} = 1 + \frac{\mathrm{k} \mathrm{T}_{\mathrm{R,eff}} \mathrm{B} \mathrm{G}_{\mathrm{aR}}}{\mathrm{k} \mathrm{T}_{\mathrm{ao}} \mathrm{B} \mathrm{G}_{\mathrm{aR}}} = 1 + \frac{\mathrm{T}_{\mathrm{R,eff}}}{\mathrm{T}_{\mathrm{ao}}} \cdot$$

Or,

(19)
$$T_{R,eff} = T_{ao} (NF - 1),$$

where: $T_{R,eff}$ = effective receiver noise temperature.

Note that $T_{R,eff}$ is a bit more arbitrary measure of receiver noise performance than NF, because it requires no reference temperature. Also, if you want to convert from NF to $T_{R,eff}$ (or reverse) be sure you measure the NF at the same T_{ao} as you use on the right-hand side of Equation (19). So now we can convert back and forth from NF to $T_{R,eff}$. By now you should have a fair understanding of what noise figure and temperature are.

Cascaded stages

Sometimes it becomes of interest to find the total noise figure for two or more stages in cascade. An example of this problem would occur if you had a new preamp in mind for your VHF receiver and wondered if it would really improve performance appreciably. We won't go into the derivation of the formula, but here it is for two stages:

(20)
$$NF_{T} = NF_{1} + \frac{NF_{2} - 1}{G_{a1}}$$

$$NF_{T} = \text{total effective NF}$$

 NF_T = total effective NF NF_1 = NF of first stage NF_2 = NF of second stage G_{a1} = G_a of first stage If you have more than two stages, the formula can be extended thusly:

(21)
$$NF_{T} = NF_{1} + \frac{NF_{2} - 1}{G_{a1}} + \frac{NF_{3} - 1}{G_{a1}G_{a2}} + \frac{NF_{4} - 1}{G_{a1}G_{a2}G_{a3}} + \dots$$

[notation same as for Equation (20)].

If it is necessary to find the total noise temperature for two stages:

(22)
$$T_{T} = T_{1} + \frac{T_{2}}{G_{a1}}$$

 $T_T = \text{total noise temperature}$

 T_1 = noise temp for first stage T_2 = noise temp for second stage

And for more than two stages, the formula is simply extended:

(23)
$$T_T = T_1 + \frac{T_2}{G_{a1}} + \frac{T_3}{G_{a1}G_{a2}} + \frac{T_4}{G_{a1}G_{a2}G_{a3}} + \dots$$

Excess noise again

In the development of Equation (17) we decided to assume the effective source (antenna) noise temperature to be T_{ao}, the actual temperature (which we further assumed to be 290 degrees K). But we know in the general case, below 700 megacycles, this is not the case, for the actual antenna noise temperature is Taleff. This would suggest that we should measure the receiver noise figure with a reference temperature equal to Ta,eff. We can see from Equation (17) that if we did this the noise figure calculated in this manner would get smaller and smaller as we decreased frequency, because Ta,eff gets larger and larger. This seems to imply that receiver noise figure becomes less significant at low frequencies.

Let's look at this another way. From Equation (18), we can define an antenna noise figure:

(24)
$$ANF = 1 + \frac{T_{a,eff}}{T_{ao}}.$$

100

ANF = antenna noise figure

But since Ta,eff increases as frequency decreases, the antenna noise figure would also increase. This would seem to imply that at low frequencies, the antenna noise figure would be so much larger than receiver noise figure, that the latter would become insignificant in the system.

What we have been hinting at in the two preceding paragraphs is that below some certain frequency, receiver noise figure is no longer an important design consideration. This is an important fact to understand. Due to the variation of T_{a,eff}, it has been determined that (using modern tubes or transistors in the front end) noise figure should not be considered in the design of a receiver for operation below about 100 MHz. This 100 MHz figure is purely arbitrary, and some present day authorities might tell you 200 MHz is a better figure.

What then are design considerations for a low-noise receiver below 100 MHz? The answer to this is primarily the cross-modula-

tion characteristic.

Our crowded DX bands today demand as little interference between signals as possible. One thing we can do to establish this condition is design our receivers for low cross- and intermodulation, so that the signals cannot mix together in the receiver and thereby create even more interfering signals. It is an unfortunate fact that a receiver cannot be designed for optimum noise figure and optimum cross- and intermodulation simultaneously. In fact the two types of considerations are in direct conflict. Consequently, we must decide between the two lines of design. Below 100 MHz we would decide in favor of low cross-modulation. Above 100 MHz we must begin to think in favor of low noise figure.

Minimum discernible signal

Our last topic will concern the minimum signal that can be detected by a receiving system. The development will be useful in that the final result will be an equation, examination of which will show how the weak signal performance of a receiving system can be improved.

Minimum discernible signal strength is defined here as the power density (at the receiving antenna) in the field of the desired signal which produces a receiver output signal power equal to receiver output noise power. We assume the antenna thermal noise is the dominant noise input component.

The input signal power under minimum discernible signal (MDS) conditions is:

(25)
$$S_i = A \times MDS |_{S_o = N_o}$$

 S_i = receiver input power A = antenna capture area MDS = as defined above



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OF OUR OWN TEST METERS **DESIGNED** BY EVANS ENGINEERS TO GIVE YOU

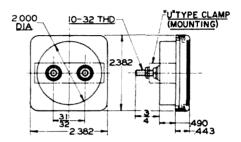
± 5% READINGS

Completely tested and in the field, this meter is a compact beauty, $2^{1}/_{2}$ inches square, and consists of a clear plastic front, metal back, well damped movement, quality metal dial, solid brass movement support for extra rugged construction, and yields on accuracy of $\pm\,5\%$ of full scale value. Mounts with U-clamp.

NOW AVAILABLE FROM STOCK

Model No.	793	DC(0-500)	MADC	\$4.00
Model No.	793	DC(0-1)	MADC	4.85
Model No.	793	DC(0-3)	MADC	4.00
Model No. 7	793	DC(0-300)	MADC	4.00
Model No. 7	793	DC(0-15)	MADC	4.00
Model No. 7	793	DC(0-30)	VDC	4.00
Model No. 7	793	DC(0-50)	MADC	4.00
Model No. 7	794	AC(0-10)	AC AMPS	5.00
Model No. 7	794	AC(0-30)	AC AMPS	5.00
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OTHER SCALES TO FOLLOW FOR AC & DC METERS



MOUNTING DIAGRAM

SINCE 1933

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CONCORD, NEW HAMPSHIRE

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(The vertical bar with $S_o = N_o$ means the equation applies when output noise power is equal to output signal power.) Now rearranging Equation (25):

(26)
$$MDS = \frac{S_i}{A} \bigg|_{S_o = N_o}$$

But $S_o = G_a S_i$; and $N_o = G_a k T_{ao} B + \triangle N$, as above when we developed Equation (17). Therefore:

(27)
$$MDS = \frac{S_o}{AG_a}$$
, and since $S_o = N_o$:

(28)
$$MDS = \frac{kT_{ao}B + \Delta N/G_a}{A}$$

Now substituting Equation (17) into Equation (28):

(29)
$$MDS = (kT_{ao}B/A) NF.$$

Equation (29) is the end result we wanted. It shows that the MDS of a receiving system increases as the bandwidth and noise figure of the receiver increase, and decreases as the antenna capture area increases. The derivation of Equation (29) did not consider transmission line losses, but it is obvious that to

keep the MDS down we must use transmission lines with small losses. Also, it should be noted decreasing bandwidth will decrease MDS, but we can only do this until receiver bandwidth is about equal to signal bandwidth, for further reduction would make it impossible to recover the intelligence in the signal.

Conclusion

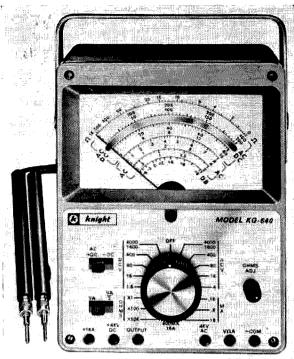
The intent of this article has been to provide a general overview of the receiving noise problem. It was particularly desired to point out when noise figure is and is not important in receiver design, and to show the relationship between noise figure, noise temperature, and minimum discernible signal strength. The author hopes that the reader has found it helpful to his understanding of noise.

. . . K6ZGQ

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The Knight-kit KG-640 VOM

If you're in the market for a volt-ohm-milliameter, the new Knight-Kit KG-640 seems to be an excellent choice. This 20,000 ohms per volt instrument has many plus features that vou don't usually find in inexpensive test meters. First of all, the meter is a taut-band unit: that is, the needle is suspended on a thin taut metal band instead of conventional bearings. Bearings, no matter how well designed, introduce a certain amount of friction. On the other hand, with the taut band movement, the friction is nil. This assures repeatability of reading plus dependable reliability. In addition, a mirrored scale on the meter face eliminates any errors that might be caused by parallax.

The KG-640 has a total of 57 different measuring ranges; many more than almost any other VOM on the market. On the DC scale, for example, the readings go from 0.8 VDC full scale (very handy for transistor work) up to 4000 volts. This range is sufficient for almost any DC voltage measurements that a ham is ever likely to make. The other ranges of AC voltage, resistance, current and dB are equally extensive. A complete list is given in the specifications below.

Although this VOM is available completely assembled, there are considerable savings if it is purchased as a kit. It is relatively easy to assemble with the very complete and easy to follow directions which are furnished. Plenty of illustrations are used throughout the text, and with the clear and concise instructions, it is difficult to make an error in construction. Total construction time is reasonable too—it

took me about seven hours to complete the VOM.

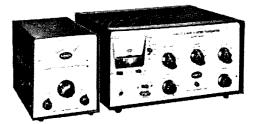
After the VOM was completed, I was very interested to find out what kind of repeatability and meter linearity I could expect. Using W2DXH's voltage calibrator (see his article in this issue), I was able to accurately measure the linearity of the meter movement. It was remarkable, in fact, almost unbelievable! At

Knight-Kit I	(G-640 Specifications
DC Sensitivity:	20,000 ohms per volt or 10,- 000 ohms per volt (function of scale multiplier switch).
Accuracy:	Within 3% of full scale reading on DC to 1600 volts; within 5% of full scale reading on AC to 1600 volts.
Frequency Response:	20 Hz to beyond 200 kHz.
DC Volts:	0 - 0.8 - 1.6 - 8 - 16 - 40 - 80 - 200 - 400 - 800 - 1600 - 2000 - 4000 volts.
AC Volts:	0 - 2 - 4 - 8 - 16 - 40 - 80 - 200 - 400 - 800 - 1600 - 2000 - 4000 volts. Sensitiv- ity 5000 or 2500 ohms per volt.
Output Volts:	0 - 2 - 4 - 8 - 16 - 40 - 80 - 200 - 400 volts.
Resistance:	0 - IK, 100K and 10 meg- ohms. Center scale values of 12, 1200 and 120K ohms.
Decibels:	-12 to +74 dB. Based upon 1 milliwatt into a 600 chm line as 0 dB.
DC Current:	0 - 80 μA, - 160 μA, - 400 μA - 800 μA - 8 mA - 16 mA - 200 mA - 400 mA - 8 A - 16 A.
Batteries:	1 flashlight, type C and 4 penlight, type AA.

 $63/4'' \times 51/4'' \times 33/4''$.

Size:

NEW VFO FOR TX-62 or any other VHF TRANSMITTER



NEW AMECO VFO FOR 6, 2 & 11/4 METERS

The new Ameco VFO-621 is a companion unit designed to operate with the Ameco TX-62. It can also be used with any other commercial 6, 2, or $1\frac{1}{2}$ meter transmitter.

Because it uses a transistorized oscillator circuit, it is extremely stable. An amplifier stage provides high output at 24-26 MC. The VFO includes a built-in solid state Zener diode regulated AC power supply.

This new VFO is truly an exceptional performer at a very low price Model VFO-621 \$59.95 net.

The NEW AMECO TX-62

In response to the demand for an inexpensive compact VHF transmitter, Ameco has brought out its new 2 and 6 meter transmitter. It is easy to tune because all circuits up to the final are broadbanded. There is no other transmitter like it on the market!

SPECIFICATIONS AND FEATURES
Power input to final: 75W. CW, 75W. peak

on phone.
Tube lineup: 6GK6—osc., tripler, 6GK6
doubler, 7868 tripler (on 2 meters)
7984-Final. 12AX7 and 6GK6 modulator.
Crystal-controlled or external VFO. Crystals

used are inexpensive 8 Mc type. Meter reads final cathode current, final grid current and RF output.

Solid state power supply.

Mike/key jack and crystal socket on front panel. Push-to-talk mike jack.

Potentiometer type drive control. Audio gain control.
Additional connections in rear for key and

Model TX-62 Wired and Tested only \$149.95

AMECO EQUIPMENT CORP.

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only one point from one end of the scale to the other did the meter deviate from a linear reading. At the five volt point on the 15 volt range, the meter indication was about 100 millivolts off. And 100 millivolts out of five volts is a pretty small deviation—so small it wouldn't even be noticed in the normal run of measurements.

Next the accuracy and repeatability tests. These were made using the same voltage calibrator. The accuracy of the meter proved to be extremely good. The DC voltage scales, as far as I could tell with my naked eye, were right on the money. Same with the AC ranges. The resistance ranges were checked out with precision 1% resistors; in every case they were very, very close to the known resistor value. Repeatability: I couldn't detect any difference in readings when making the same voltage measurement several times. A 10 volt source showed up as exactly ten volts on the meter each time I put the probes across it.

If you're in the market for a VOM, you should definitely take a close look at the Knight-Kit KG-640. For accuracy, reliability, and dependability, it would be difficult to find a better instrument value for \$39.95.

. . . W1DTY

CONVERTER SALE

6 METER SOLID STATE RF CONVERTERS

2 db NF, .2 μ v for 6 db signal to noise ratio, mil. spec. epoxy glass printed circuit board, variable forward gain control, built-in power supply available for all models. 2N3823 FET front end available for 1.5 db NF and reduced cross-modulation effects.

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Model	Input MHz	Output MHz	Price
88610	50-54	14-18	\$21.95
SS610F	Same as above	but FET rf amp.	39.95
SS611	50-54	7-11	21.95
SS610F	Same as above	but FET rf amp.	39.95
SS510	50-54 MHz rf	pre-amplifier	9.95
SS511	50-54 MHz FE	T rf pre-amplifier	29.95
SS600X	Special IF (.6-	-30 MHz)	24.95
S8600XF	FET special IF	(.6-30 MHz)	42.95
	For built-in po	wer supply, add	5.00

For prompt shipment of stock models include postal money order or cashier's check. Special models shipped within six weeks. Personal checks must clean before shipment. Include 20% deposit for COD.

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73 Looks at the Motorola HEP Line

Motorola's new experimenter transistors have many ham uses.

If you've been in a radio store recently, you've probably noticed a large display full of mouth-watering Motorola semiconductors. The display (and the items in it) are part of the new Motorola HEP program. The H, E and P stand for Hobbyist, Experimenter and Professional, and that's who the program is aimed at. The HEP semiconductors are designed for radio-TV servicemen, experimenters, schools—and hams. Naturally, we're most concerned about their ham uses, and they have plenty.

The HEP program means that now many common and exotic semiconductors with excellent performance are finally available at local radio and hobby stores-and at reasonable prices. The HEP line is very extensive; it even includes some digital integrated circuits and a field effect transistor. Most of the items are lower in price or about the same as competing experimenter-hobbyist transistors, but the HEP line is much more extensive. You can buy cheaper versions of many of the devices from industrial distributors under other names and in different cases, but the HEP line is widely available. That's a great boon to most hams even if it means that the transistors cost a few cents extra.

I've had a chance to try some of the HEP devices, and I've found them excellent. All the ones I've been able to check beat the specs Motorola publishes. Here's a quick look:

The HEP-1 is a "standard" PNP germanium mesa transistor. It costs 89¢ and is useful in most low power experimenter circuits: af amplifiers, if amplifiers, regenerative and superregen detectors, oscillators, etc. It easily oscillates to 250 MHz in a simple dipper I have.

The HEP-2 and HEP-3 are low power, high frequency germanium transistors. They have cutoff frequencies of 750 and 250 MHz and betas of 60 and 80.

The HEP-50 through 53 are 300 and 600 mW silicon PNP and NPN transistors for the HF and low VHF range. They are useful for everything from CPO's and meter amplifiers to low power transmitters. V_{CB} is listed from 10-20 V, so they're not suitable for most modulated amplifiers or other circuits with inductors unless you use very low voltage. Cost is 79¢ to \$1.29.

A group of recently announced transistors seems to have been added with the ham in

mind. They're four tiny silicon plastic transistors for VHF use. The numbers are HEP-54 to 57 and three are NPN, one PNP. Dissipation without heat sinks is 310 mW. Cutoff frequencies range from 30 to 750 MHz and beta from 70 to 180. Prices are \$1.08 to \$1.44. All four show very low input and output capacitance.

HEP-101 is a 10-V, 400-mW 95¢ zener, and HEP-102 through 105 are 1 W zeners for 3.6, 6.2, 9.1 and 12 V. They cost \$1.20 each.

HEP-151 through 162 are various silicon rectifiers rated from 1 A to 15 A and 50 to 1000 PIV. The 15-A ones are stud mounted, and come with mounting kits, the 3-A ones are top hats, and the 1-A ones are tiny (smaller than ½-W resistors) epoxy-cased units. As examples of prices, the 15-A, 50-V HEP-151 is 79¢; the 1-A, 400-V HEP-157 is 56¢; and the 1-A, 1000-V HEP-160 is \$1.45.

Especially interesting are the miniature (%" \times %") HEP-175 through 177 bridge rectifiers rated at 1 A from 50 to 400 PIV. They cost \$1.49 to \$2.25.

HEP-200, 230 and 231 are germanium power transistors. 200 and 230 are 3-A TO-3 cased units (about 85¢). The HEP-231 is a 15-A, TO-36 high power transistor. It comes with mounting kit and costs only \$1.69.

The HEP-232 and 233 are high power, high voltage units: 70 V, 7 A, 90 W and 65 V, 15 A, 150 W respectively.

HEP-250 through 254 are germanium PNP audio transistors, including a low leakage one.

HEP-300 through 307 are silicon controlled rectifiers (SCR's). These incredibly useful devices haven't been used much by hams yet, but we should see more and more of them. They make excellent switches and relays for vibrator replacement, speed controls, etc. The HEP units are rated at 5 and 15 A and 50 and 200 V. They come in both normal and reversed polarity with mounting kits for \$2.29 to \$6.20.

HEP-309 and 311 are triggers for use with SCR's. HEP-310 is a unijunction silicon transistor; its price is \$1.49.

HEP-553 through 558 are digital integrated circuits. See the article by W6GXN in the December 73 for some uses for them. They cost \$1.69 (for a bias driver, a fancy regulated power supply) to \$5.99 (J-K flip-flop).



Jack Morgan K1RA Greenfield, N.H.

Knight-Kit TR-102

Two-meter equipment has come a long way in the past 25 years. A look at the gear we used in the W.E.R.S. activity during WWII would make you shudder: modulated oscillators that drifted all around the band, and super-regen receivers that could radiate almost as much as the transmitters.

At a meeting of the Old Timers in Trenton, N.J., in 1946, the late John Reinartz, W1QP, showed us a five-tube, crystal controlled two-meter rf source, built on a 3 x 8 inch chassis. He plugged in a 4.5 MHz crystal at one end, and a small flashlight bulb lit up at the other. We were amazed that those receiving tubes could put out anything at all on two, especially with the final tube doubling. But we were progressing.

Things are very different today on two, and kits have little resemblance to those of the early days. One of the most interesting recent kits is Allied's Knight-Kit Model TA-102. Similar basically to the Model TR-106 that was

discussed by WA1CCH in the August issue, this one has an additional multiplier, and coils that are well designed for two. Output is a good 10 watts over the entire band with either VFO or crystal control. The Model V-107 VFO unit is an accessory that plugs into the rear deck and gives a very neat appearance along side the TR-102.

The instruction book gives you two chances to do everything right the first time: clearly worded text, with a picture to show exactly what is intended. You would almost have to make an error on purpose to get into trouble. The kit we assembled gave no problems and produced the expected output.

Here is a very inexpensive way to get on two meters with a good modern transceiver, ready for either mobile or fixed operation simply by using the appropriate power cable. We expect to hear TR-102's in ever-increasing numbers in round tables, emergency and mobile work. See you on two with a TR-102.

The HEP-801 is an N-channel field effect transistor for low frequency and dc uses. It costs \$3.39.

Also included in the HEP displays are heat sinks, IC sockets, TO-3 mounting kits and a number of books and pamphlets. A couple of the books are discussed briefly on page 87 in the October 73.

The prices quoted above may vary a bit

from different stores. You can get a complete list of HEP distributors and a catalog from Motorola HEP, Box 955, Phoenix, Arizona 85001. Incidentally, the new Allied consumer catalog lists the HEP-devices with their prices. Whether you order them by mail or buy them locally, try some of the HEP semiconductors. You'll like them.

... WA1CCH

A Junkbox Ten Minute Timer

Here is a ten minute timer which will serve as a reminder when its time to identify in those SSB contacts. If you have one of these you can give the kitchen timer back to the XYL and perhaps avoid a citation at the same time.

The circuit uses a 12BY7 to control a sensitive relay in the plate circuit, which in turn centrols a warning light to tell you when the time is up. The tube is normally in a conducting state and the light is on. When the normally open momentary contact pushbutton is depressed, a negative voltage, rectified by CR1 is applied to the grid of the tube, biasing it beyond cut off and extinguishing the light. At the same time the 8 µF capacitor charges to about 175 volts negative. As long as this capacitor remains charged sufficiently the tube can not draw enough current to energize the relay and turn on the light.

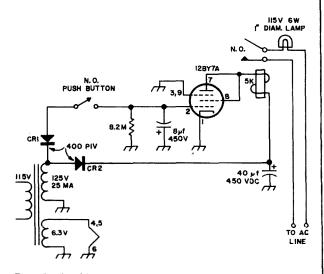


Fig. 1. Junkbox ten minute timer.

The capacitor slowly discharges through the 8.2 M resistor until after about 9.5 minutes the relay pulls in and the warning light lights. A push of the button starts the cycle over.

The discharge time of the $8 \mu \dot{F}$ capacitor is controlled by the value of resistance across it. The 8.2 M resistor shown gave a time of 9.5 minutes which was considered close enough. If the resistance is increased the time will be longer, if it is decreased, shorter. A change of one megohm will change the time by about a minute and 10 seconds.

. . . Fred Davis K8DOC

Propagation Chart

JANUARY 1967

Issued November 12, 1966

J. H. Nelson

EASTERN UNITED STATES TO:

	6	C B	10	12	14	16	18	20	22
7		7	1	7	7*	14	21	21	21
.14		7	7	14	21	21	21	21	23
7*	•	1.	7*	7*	14*	14	14	21	21
7		7	7	14	219	314	21	21	21
7		1	7	14	21*	21*	14	14	7
7*		7	7	7	7*	14	21#	21	21
7.	•	7*	7*	14#	14	14	7*	7*	7
7*	•	7	7	7	7	7*	7*	7*	14
7	,	7	7	7	14	21	21	21	21
2.	•	7*	7.	7	7	7*	7*	7*	7*
7		7	7	14	21	21#	21	21	14
7		7.	14	21	21*	210	216	21	14
7		7	7.	14	21	14	7*	7*	7
7		7	7	7	14	21	21#	21*	21
	+	+	+	1 1 1			 	+	+

CENTRAL UNITED STATES TO:

ALASKA	14	14	7	7	7	7	7	7	7*	14	21	21
ARGENTINA	14	14	14	7	7	7	14	21	21	21	21	21
AUSTRALIA	21	14	7.	7*	7•	7*	7*	7*	14	14	21	21
CANAL ZONE	21	14	7 #	7	7	7	7#	21	21#	21	21	21
ENGLAND	7	7	7	7	7	7	14	21	21#	14	14	7*
HAWAII	21	14	14	7	7	7	7	7.	14	21	21#	21
INDIA	7	7	7.	7*	7*	7*	7*	14	14	7*	7*	14
JAPAN	21	14	7*	70	7	7	7	7	7	7*	7*	14#
MEXICO	14	7	7	7	7	7	7	14	14	21	21	14
PHILIPPINES	21	14	7*	7*	7*	7	7	7	7	7*	7*	14
PUERTO RICO	14	14	7	7	7	7	14	21	21#	2₩	21	21
SOUTH AFRICA	14	7	7	7	7*	7*	14	218	219	21#	21	14
U. S. S. R.	7	7	7	7	7	74	7*	14	14	7*	7*	7*

WESTERN UNITED STATES TO:

ALASKA	21	14	7	7	7	7	*-	7	7	14	21	23
ARGENTINA	21	2.6	14	14	7	7	7	14	21	21	219	21
AUSTRALIA	21	21#	14	14	14	7*	7*	7*	14	14	21	21
CANAL ZONE	21	14	14	7 *	7	7	7	14	21*	21#	21	21
ENGLAND	7*	7	7	7	7	ī	7*	7*	14#	14	7*	7*
HAWAII	21	21	14	14	7	7	7	7	14	21	28	23
INDIA	7*	14	14	7*	7*	7*	7*	7	7.	7*	7*	7*
JAPAN	21	21	14	7*	7	7	7	7	7	7*	14	21
MEXICO	14	7.8	7	7	7	7	7	7	14	14	21	14
PHILIPPINES	21	21	14	7*	7*	7	7	7	7	7*	7*	14
PUERTO RICO	14	14	14	7	7	7	7	14	21*	21#	210	21
SOUTH AFRICA	14	;	7	7	7*	7*	1.	14	21	21.#	21#	14
U. S. S. R.	7*	7	7	7	7	7	7*	1.	14	7*	7*	7*
EAST COAST	21	14	7	7	7	7	7	14	21	21#	21#	21

Very difficult circuit this hour.

* Next higher frequency may be useful this hour.

Good: 1, 2, 9-13, 16-22, 28-31 Fair: 3, 4, 5, 14, 15, 23, 24, 27 Poor: 6, 7, 8, 25, 26 VHF DX likely: 12, 13, 21, 27

Letters

More Non-Technical Articles?

Dear 73:

How about running a few not-so-technical articles in each issue of 73. You see, not every amateur is a Marconi or a De Forest; therefore, I suggest that you divide your magazine into three sections: one for the advanced amateur, one for the average amateur and, lastly, one for the so called "button pusher" type amateur. This way, I believe, all hams will be able to enjoy your publication, not only the experts.

Robert Mauro WB2UHY Whitestone, New York

Modern Hamming

Dear 73:

Just finished reading "Remove the Drudgery from Ham Radio." It is a great idea, but why bother with all that expensive equipment anyway? There is a very cheap way to do our hamming today—by telephone! S-9 signals, no QRM (except on party lines), no QSB, no TVI, no license tests, no unsightly antennas on the roof. . . . The telephone company will even keep a log for you (of out-of-town calls, at least).

Jerry Blakeslee WB2VUC Pitman, N.J.

Dissatisfied Reader

Dear 73:

Please enter my subscription to 73 for two years. I enjoy the construction articles and also the editorials. I would much prefer to see more articles, though, and less space devoted to letters from dissatisfied readers.

J. H. Shoemate WA6LTJ San Jose, California

Chess Cover

Dear 73:

My husband, WØYEG, is an ardent subscriber to 73 Magazine, and consequently, you can find one or more issues in almost every room of our house. I'm not particularly interested in ham radio, but I am interested in magazine covers and advertisements. Your covers are always attractively done but the November issue wins the prize! Hats off to the bright fellow who's responsible for this exceptionally clever cover! It ranks number one on my list and I have a feeling that it'll be a long, long time before any cover tops this one.

Lorrie Dodge Omaha, Nebraska

Microwave Propagation

Dear 73:

Received my copy of the November issue of 73 with the article "Amateur Microwave Propagation" and I'd like to offer the following comments.

On page 100, second column, 7th and 8th lines, I recommend against using two antennas to serve one transmitter since this will surely result in a "multipath" condition with fading and distortion being the result. The method is okay for receiving though.

On page 103, in the descriptive note for Figure 7, the formula for computing gain got a little gnarled in the composing room. It should read: Gain (in dB) = 20 log $f + 20 \log D - (52.6)$.

On page 104, in the notes for Figure 9, 3rd line from bottom of page, sine conventions, should read "... negative when the angle slopes up.")

Ray Thrower WA6PZR San Carlos, California

Horseflies

Dear 73:

Keep up the good work. You have a wonderful magazine. As an older man, and an advocate of "Law and Order", I am for the ARRL 100% but we certainly need 73! We need for Wayne to keep the ARRL from becoming too stodgy. You have already had an influence on QST—their journal has noticeably improved in the past few months, so please keep sniping.

Bob Bergner, M.D., K4JBK Louisville, Kentucky Dear Wayne,

It looks like the ARRL is trying to put themselves out of business. All this carping about home-made equipment and technical proficiency is beginning to get me down. After all, if the hams wanted to be professionals they would do so. Another thing that irks me is this retesting business. At least a dozen of my friends have pointed out that they got their licenses in good faith and now the implication is that they are a bum or a crook or something. I suspect that a good percentage of the old timers wouldn't even try to pass a new test. Ham radio can only service with numbers and we won't have them with a sword hanging over our neck. I've been in radio for over 36 years and I've never heard as much hate and discontent as these ARRL proposals have caused. QST wonders how come new licenses have fallen off . . . I feel for them.

Bob Wilson KIGVA Portland, Maine

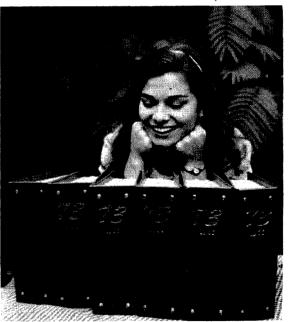
New Reader's Comments

Dear 73:

Just a day ago I wrote to raise the devil because I had been waiting over two months to get your rag after sending you my good dough. One day after it is in the mail box the rag arrives. I don't write letters and never did but after a glance at this I just had to drop a line for what it is worth. Sure I been hearing all the propaganda about you-what ham hasn't the past few years-well I got that 73 (finally) and doggone, I sat down with it and didn't get up till I went over it from cover to cover (cost me some sleep). Well contrary to what I had heard, I like the thing. The articles are really good. I enjoyed the rambling style—I like the construction articles—I like the Editor's Ramblings—I like Wayne's column "de W2NSD"-In fact I like the whole d--- thing so much I'm gonna try to gather up enough loot to try to get all the back issues in the near future. By the way, I do a lot of building (not the novice stuff), as I been in the game a couple of years myself, and I like the saddlestitching because I do use magazines on the work-bench to build stuff from articles. You got a new one on the string and I even would like a copy of you booklet "Writing for 73". A self-addressed envelope is enclosed and I am even putting a stamp on it. You might be hearing from me again and if the mags are all as interesting to me as this first one has been, you will have me around for a long time.

Keep up the good work. Some of us can appreciate it.

C. G. Stuart W8TZO
Toledo, Ohio



That's W7IDF's pretty daughter Thea admiring the 73 binders. Have you ordered the binders you wanted?

Technical Aid Group

The first members of 73's Technical Aid Group are listed below. They are willing to help other hams with their technical problems. If you have a concise question that you think can be answered through the mail, why not write to one of the hams on the list? Please type or write legibly, and include a self-addressed stamped envelope. One question to a letter, please.

George Daughters WB6AIG, BS and MS, 1613 Notre Dame Drive, Mountain View, Calif. Semiconductors, VHF converters, test equipment, general information.

Roger Taylor K6ALD, BSEE, 2811 W. William, Champaign, Ill. 61820. Antennas, semiconductors, product data, general.

Jim Ashe W2DXH, R.D. 1, Freeville, N.Y. Test equipment, general.

If you'd like to join the Technical Aid Group and you feel that you are qualified to help other hams, please write us and we'll furnish complete information. It's obvious that we need many helpers in all parts of the country and in all specialties to do the most good. While 73 will try to help with publicity and in other ways, we want the TAG to be a ham-to-ham group helping anyone who needs help, whether they be 73 readers or not.

Don Nelson WB2EGZ, EE, 9 Greenridge Road, Ashland, N.J. 08034. VHF antennas and converters, semiconductors, selection and application of tubes.

Tom O'Hara W6ORG, 10253 East Nadine, Temple City, Cal. 91780. ATV, VHF converters, semiconductors, general questions.

Stix Borok WB2PFY, high school student, 209-25 18 Ave., Bayside, N.Y. 11360. Novice help.

(Editor's Ramblings from page 4)

high gain antennas, and low noise stable transistor converters) have reduced the early problems of UHF quite a bit. After some flustering and discussion, Congress passed the All Channel TV Law, which requires all TV sets now sold in the US to be able to receive all 82 channels. The hope was that the public would buy enough new sets to insure that most people could receive all channels in a few years, though some claimed that the increased cost of the sets (UHF tuners add about \$20 or less to the cost of most sets) would ruin the TV manufacturers since no one would buy the more expensive sets.

These critics were wrong. Tax reductions and prosperity, plus the recent color TV set boom and the increasing number of two (or three) set families have caused such a turnover in TV receivers that it won't be long before most US families can receive all stations, VHF and UHF.

Then the time will come for the inevitable change that VHF broadcasters have been fearing: All TV must move to UHF. This will certainly not help their competitive position, but it will give them a few advantages: UHF TV is generally less bothered by ghosts and co-channel interference than VHF, and the wider

flat bandpass available at UHF often gives better reception of color TV than VHF. Also, UHF suffers no skip interference.

Vacating the VHF band will release 72 MHz for other services. Perhaps a few megahertz more should be added to the FM broadcast band, and legitimate users of CB deserve some VHF frequencies where they won't be bothered by skip. But a great deal of those frequencies should go to businesses. Perhaps 25 to 50 MHz wouldn't be excessive in view of the number of present and prospective users. With 10 kHz channels, that would be 2500 to 5000 channels.

This change would save the still-little-used VHF ham bands for the future when they'll undoubtedly become more and more important. It also would provide the vital frequencies needed for two-way radio without adopting such suggested stop-gap measures as using unused TV channels permanently.

Writing for 73

Would you like to try your hand at writing some articles for 73? If you would, we've got a small booklet, "Writing for 73," which you can have for a self-addressed business envelope. I've also made up a list of articles I'm looking for if you'd like that.

. . . Paul

What's New for You?

This is the first in our new monthly series devoted to short, timely items of interest to technical hams. We're going to concentrate on practical developments that are of use to hams now-or will be very shortly. Among the topics we'll cover are new semiconductors and circuits, other new components, newly available surplus, technical nets, technical meetings, and so forth. All items will give credit to the sender. Please get them in to us as soon as possible so all interested hams will be able to take advantage of them quickly. The deadline for an issue is the 15th of the second month preceding the date on the cover. For instance, items to be in the March issue should be here by January 15. Please keep your contributions short for this column. Long items should be submitted as articles.

Paul Franson WA1CCH

Motorola \$1 FET

If you have been neglecting to use field effect transistors because of their high cost, the new Motorola MPF103, 104 and 105 may be just what you're looking for. These new transistors cost \$1.00 in quantities up to 100 and are available through Motorola dealers. All of these devices have a maximum drainsource voltage rating of 25 volts, gate-source voltage rating of -25 volts and 200 mW dissipation. The only difference between the units is in the forward transfer admittance (y_{fs}) and zero-gate-voltage drain current (I_{DSS}). Typical values for the MPF103 are $I_{DSS} - 3$ mA, $y_{fs} - 3000$ µmhos; MPF104, $I_{DSS} - 6$ mA, $y_{fs} - 4000$ µmhos; and MPF105, $I_{DSS} - 9$ mA, $y_{fs} - 4500$ µmhos. The low value of input capacitance, typically on the order of 4.5 pF and the reverse transfer capacitance of 1.5 pF result in excellent operating characteristics well into the VHF bands. As a test, a 200 MHz Colpitts oscillator was constructed using these FET's. All of them worked well in the circuit; in fact, two of the devices out-performed a common five dollar variety. Excellent results were also obtained in a 3.5 to 4 MHz VFO using the Clapp circuit and in several rf amplifier circuits up to 50 MHz. Although I have not tried it, 1 suspect that these transistors might work well in a two meter converter.

Jim Fisk W1DTY

95¢ Fairchild FET

Fairchild's new 2N4360 silicon P-channel field effect transistor costs only 95¢ in small quantities. The low price is partly a result of its epoxy case. Maximum voltage for it is 20 V, dissipation is 200 mW, input capacitance is a maximum of 20 pF, and feedback capacitance is only 3 pF. Typical forward transconductance is 3000 µS (microsiemens or micromhos). This FET is designed for low frequency use, but shows some promise in the HF range.

WA1CCH

\$1 TI FET

There's been a lot of talk about the new Texas Instruments TIXM12 P-channel germanium field effect transistor. It's designed for VHF use—typical noise figure is 2 dB at 100 MHz. It sounds perfect for six and two meter converters as well as HF uses. The only problem is that it's not available. This seems to be the TIXM05 story all over again. When and if these very promising-sounding FET's become available, we'll let you know.

WA1CCH

15¢ GI Transistors

General Instruments has recently introduced a number of very cheap epoxy-cased silicon transistors. They're made in Taiwan and cost as little as 15ϕ if you buy a lot of them. Individual prices run a little more, but not much—about 40 to 50ϕ . These transistors are useful for many ham applications as amplifiers and switches. F_T is 200 to 250 MHz minimum, and they come in PNP and NPN pairs. Among them are the 2N4140-2N4143, and 2N4227 and 2N4228. They work well in general purpose applications.

WA1CCH



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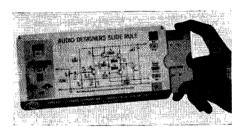


New ATV Catalog

If you're interested in ham TV-or think you'd like to get interested in ham TV-you'll certainly want the new 1967 catalog from ATV Research. It's 20 pages thick and contains all sorts of gear of interest to TV'ers. Best of all, it's free! Send your name, address and zip code to ATV Research, P.O. Box 396, South Sioux City, Nebraska 68776.

TI Audio and AM/FM Handbook

Texas Instruments has just published a new book in their useful handbook series. This one is about the design of audio amplifiers and AM/FM tuners. While it's devoted to consumer applications, it's obviously also very useful to the ham who designs. The book is thoroughly practical; it even gives photos and printed circuit board layouts for some receivers. The name is Audio and AM/FM Circuit Design Handbook and it costs \$3. You can buy a copy from any TI distributor or from TI Technical Publications, MS75, P.O. Box 5012, Dallas, Texas.



Amperex Audio Slide Rule

Here's one of the cleverest and most useful gadgets we've seen in some time. It's a handy slide rule for audio circuits. One side (shown in the photo), shows a basic audio system with a slide that gives the proper parts values for different transistors, power levels and voltages. The amplifiers range from a one watt, 9 volt amplifier to a 12 watt, 28 volt one. All use the excellent complementary symmetry circuit which provides excellent results with no transformers. The back of the rule is a more conventional slide rule for designing audio circuits. Any audio designer should have this rule. It costs only 50¢, and is available from Amperex Semiconductor Division, 230 Duffy Avenue, Hicksville, N.Y. 11802.

Aladin Breadboarding Kit

Aladin Kits has introduced a new bread-boarding kit that should fill the needs of just about all electronic experimenters and hams. This kit contains a punched phenolic deck, an aluminum mounting base, several brackets for mounting switches, pots and transistor sockets, silver plated solderless connectors and an assortment of assembly hardware. The terminals contained in this kit are designed so that circuit connections may be made easily and efficiently without soldering. This is extremely helpful when designing and building circuits. For more information, write to Aladin Kits Company, 21011 Dequindre Road, Hazel Park, Michigan 48030.

New Meshna Catalog

John Meshna's just published a new catalog. You'll eat your heart out looking at his goodies contained in this fat 72 page book. Meshna's catalogs certainly must be the best surplus catalogs around; he doesn't just list the gear with prices, but tells you what it's good for. He writes with much wit, too. You've got to get this catalog; send John the 25¢ today. You'll hate yourself otherwise. Meshna, 19 Allerton St., Lynn, Mass.

Building Your Amateur Radio Novice Station

Most beginners will tell you that the hardest thing about ham radio is getting started. In addition, many of them say that most articles and books describe equipment which is either too complicated or do not furnish sufficient construction details. Howard S. Pyle. W70E, has put together a construction manual for building an amateur novice station with the complete details that many people have been looking for. YB Pyle describes a professional-looking transmitter and receiver which cost very little to build. They have been thoroughly tested for ease of construction and for on the air performance. Nothing is overlooked in the construction phase; full size drilling and cutout templates for chassis and panels are included within the pages of this book. They may be fastened directly to the chassis and panels and used as a guide for drilling all the necessary holes. While the completed equipment has been specifically designed for the novice operator, it will serve the General-Class amateur as well. The price of this new book is \$3.50, and it is available at your local distributor or from the publisher, Howard W. Sams & Company, 4300 West 62nd Street, Indianapolis, Indiana 46206.



Heath's New Single-Banders

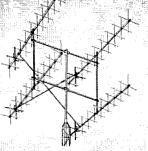
When Heath announced their single-band SSB transceivers a few years ago, no one could believe their low price of \$120. Now they've improved the already-excellent transceivers and reduced the price! In addition to all of the features we already know about-low cost, small size, high performance, easy construction -they've now added front panel selection of sidebands, improved audio and AGC, mike and gain control, more convenient front panel arrangement, a mode switch position for the optional 100 kHz calibrator, ALC input for use with linears, and power connectors and up-dated styling to match the SB-line. And the prices: \$99.95 for the HW-12A (75 meters), \$104.95 for the HW-22A (40 meters) and HW-32A (20 meters). Write to Heath, Benton Harbor, Michigan for more information.

Transistor Circuits

K. W. Cattermole's Transistor Circuits is a very good circuits reference book which would be an excellent addition to any serious amateur's library. The circuit descriptions in this new edition of a well known volume (in engineering circles) are clearly written and not highly mathematical, although a working knowledge of algebra is helpful. It gives a clear insight to circuit operation and provides the reader with much practical, useful, and worthwhile design data. The 70 page chapter on high frequency amplifiers should be particularly interesting to hams. This chapter is very well done and covers internal feedback and neutralization, gain limiting and multistage amplifiers, coupling networks and wideband amplifiers. Other chapters cover bias supplies and stabilization, power amplifiers, oscillators, modulation, detection and mixers, and binary and computer circuits. In addition, six appendices contain data, although quite mathematical, of use in detail circuit design. This book is highly recommended for the amateur with a strong technical background. \$14.50 at your bookstore or write to the published, Gordon and Breach, 150 Fifth Avenue, New York, New York 10011.

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the U.S.

Fellows listening to some of the ridiculous pile-ups on 20M may think I am off my beam, but I've done enough working from the rare end now to speak with some authority on the problem. The DX operator, I feel, is entirely responsible for any mess that builds up. It is his show and he can run it as he wants. Through a lack of experience or stupidity he can allow fellows to break in on him, tail end, or call endlessly. The sharp op can size up the crowd for him easily, as I pointed out last month. If he is operating transceive. . . . I'm speaking primarily of sideband now . . . he can work fast break-in, allowing no more than five or six seconds for callers. If he wants to see how many are waiting he can ask for one call from all waiting and see how finely he has to break down the group to get individual call letters through. Usually the band is open to certain call areas or countries and these can be broken down into prefixes on fast breaks ... WB2, WA2, etc. If the fifth area is weak a simple request for fives is enough. Ditto calls from other countries, which can be handled exactly the same.

The major problem is how to get the DX stations to operate efficiently. I've tried to explain to them over the air and almost without exception they continue on doing exactly as they were before, grumbling about the QRM and making one contact every few minutes.

More Safari

OK, sports fans, I'll try to carry on my narrative from the October editorial. Mind you, ham radio plays a small part of the following so buzz off if you read True or Sports Afield and get your thrills there.

During the first two weeks of our hunting Larry and I had taken turns shooting, with one of us waiting in the Land Rover while the other went out and stalked the game. This had gotten to be quite boring and we decided to try going out on alternate days and see how that would work. Larry (WA6TCI) went out the first day with Jim (W5PYI) along to take pictures while I sat back at the "hotel" writing my October editorial. This kept me pretty busy for the day with just enough time to hike the half mile into Nanyuki and look the town over carefully and buy a couple of Ruark books (Something of Value and Uhuru, both of which I recommend most highly).

On Sunday it was my turn. I was worried . . . Larry had been out shooting zebra all day Saturday. He'd gone out at 6:30 in the

morning and come back at 8:30 with two nice zebras. He'd gotten up to about 60 yards from a herd for the first one and 100 yards on the second. In the afternoon Larry came back for lunch and reported that the herds were now quite alert and he wasn't able to get in close for another shot. Just before dinner he and Freddy, our White Hunter, closed in on a good sized herd and Larry shot at a good specimen . . . then Freddy shot . . . no results . . . they both shot several more rounds into the rapidly disappearing herd and brought down one little foal as the only casualty. Very embarrassing.

Sure enough, when I went out on Sunday the zebra were very spooky and we just couldn't get close to them at all no matter how we tried to sneak around. In desperation I tried a very long shot after an hour and a half of tracking a herd . . . I missed. We followed them for another hour and a half and then gave up and went back to the hotel for breakfast.

Hiking through the brush at a crouch for three hours at 6000 feet elevation is particularly tiring. After breakfast I snoozed for a half hour to recoup. At 10:30 we were off again driving through the thousand acre paddocks looking for zebra herds. It is amazing how difficult those brightly striped animals are to see at a distance. Nothing in sight. We took off on foot again and by 11:30 we had a small herd in sight. Ten minutes later I was within shooting range and carefully drew a bead on a large stallion . . . wham! I missed. Rats!

Kerede, my gun bearer, followed the herd with me racing along behind him. I don't know how he knows which way they've gone, but we veered this way and that with nothing whatever in sight and in ten minutes had them back in range. I wasn't going to miss again, you can be sure. I steadied the gun against a thorn tree and settled down for a very careful shot . . . about 150 yards . . . nothing to it. Blam! Off they went, another miss. I must have a subconscious wish to spare zebras. This is ridiculous . . . and very humiliating.

We went back to the car and started looking again . . . aha, a good sized herd of zebra over across that large open plain. Kerede and I got out and stalked through the bush on the edge of the plain while the car continued on as a decoy in the other direction. As we got in closer we could see they were still grazing calmly . . . then suddenly a raucous cry from two "get away" birds rang out above us . . . get away . The zebras did.

After a late lunch and an afternoon siesta we went out for one more try. By 5:30 Kerede and I were trailing a herd of zebra mixed with impala . . . this was a spooky group and we just couldn't get in close. I fired one shot at 130 yards as they started off again for my third miss of the day. So much for Sunday.

My marksmanship just wasn't that bad, I knew, so I began to suspect that something was amiss with the gun. Larry, back at the hotel, agreed. His shots the previous night had been easy ones too and he still had missed. Obviously something was wrong with the sighting scope.

Monday at mid-morning Larry returned with another zebra, this being his day for shooting. That's four for him, counting the foal they'd bumped off by accident . . . and I haven't gotten a one. Say, what about the sighting on the rifle? Oh, they'd checked that and it was perfect. So much for our excuse for missing. Larry went back out after zebra again, but they were wise by now and he never got another shot at them the rest of the day.

Secret Valley

Most of us have heard about the Tree Tops Lodge in Kenya, a hotel built among the tops of the trees where visitors can watch the wild game coming to feed. Shamsu Din has built his own version of Tree Tops up on the side of Mount Kenya at about 8000 feet and calls the little glen and pond it overlooks Secret Valley. We all drove up there for a night to have a look at the leopards which come there every night to feed . . . Larry's zebras being the meal for this evening.

To get to the lodge you drive by Land Rover up the side of the mountain and park in a small clearing and then hike a couple hundred yards along a small trail through impenetrable forest. The bamboo and vines grow around 200 foot high trees with not enough room for even a person to get through. It was dark and alarming going down the trail, but the hotel guests were reassured by Shamsu standing guard with his big rifle and full cartridge belt. Larry and I weren't so happy because we knew that those bullets were the wrong size for the rifle and the whole thing was for show. Shamsu wouldn't let us bring our rifle . . . we'd been teasing him too much about popping off one of the leopards that come in to feed.

On some nights they have as many as eight or nine leopards turning out to feed on the platform just about twenty feet from the porch

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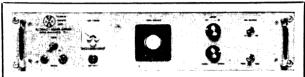
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C. LeRoy Kerr, WA6CTK
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of the lodge. They have lights rigged up so visitors can take pictures right up close. I was all set with my super telephoto, but only one leopard slunk around this night and he never got up in the light. I did get some pictures of bushbuck and water buffalo though.

Secret Valley Lodge is rustic. The rooms are very simple: rickety bed, table, lamp and a couple of hooks on the wall for your clothes. The rates are \$14 a night, but you can strike a bargain with Shamsu if he isn't filled up. I have yet to meet an Indian that you can't bargain with . . . it seems to be part of their heritage. I've met few that I didn't have to bargain with.

Our separate day arrangement for hunting didn't work out very well for Larry, I had no problem keeping myself amused on my day off with writing, horseback riding and things. But Larry had nothing to do and while I was out hunting on Sunday he sat around the hotel with his teeth in his mouth and got bored silly. He and Jim walked down town Nanyuki, but there was nothing to do there but watch haircuts. They tried taking pictures of the town, but every African that happened to be within camera range came over and demanded a shilling. By Sunday night Larry and Jim were ready to go back to Nairobi rather than face another day like that.

Ignoring my carefully laid plans and hotel reservations for the rest of the trip they took off Tuesday morning for Nairobi, leaving me to hunt for two more days by myself. Well, OK, I've still got special licenses for an oryx and an eland, perhaps I'll get one or both. I can meet then in Nairobi at the end of the week and get back on schedule. And I still want that zebra.

Piga Punda

Up at 6 . . . dress in my bush pants and shoes . . . shirt and bush jacket to ward off the cold, 50° this morning. Pour the tea in the sink . . . no way to prevent the boy from bringing it in the morning and I don't want to make them unhappy by not having it appear to be drunk. Freddy arrives with Kerede and Labun . . . we're ready to get a punda (zebra).

After an hour or so of bumping along through bush country without nary a speck of zebra hide showing we pulled up at a native hut and, after a lot of fast Swahili discussion, one of the Africans led Kerede and me into the bush on foot. Inside of ten minutes we've spotted a herd. Kerede isn't taking any chances on my marksmanship this morning, he guides me in close. The zebra are uneasy . . . they

move off a bit . . . we follow, freezing when they look our way. They move off some more, we sneak along, hiding behind one inch thick trees. I take very careful aim and get off a shot at about 90 yards. The zebras take off immediately at top speed, but Kerede says piga (hit) . . . and off we go after them. Within five minutes we have them in sight again and the one I hit is limping badly. I aim carefully again and drop him. He is a big fellow with a beautiful skin.

We tried to follow the herd for another shot, but they weren't about to let us get within 200 yards. The afternoon was just as non-productive. Freddy had to get on to another safari, so he and his bearers were replaced by Prince Sam Sapieha (from Poland) and his bearer for my last two days of hunting.

How to Shoot an Oryx

Sam and his bearer Katimba joined me at 6:30 the next morning and, after checking my rifle out on the rifle range to make sure that it and I were shooting OK, we headed into the zebra territory for one more zebra try. Sure enough, there they were, a half mile away. We got out of the Rover and stalked them carefully. Just as we got to about 150 yards from them they melted away. We couldn't figure how they had spotted us so quickly when an African walked by . . . he had scared them off, not us. We tracked them for an hour and a half more, but they were with some impala and we just couldn't fool both groups at once.

After a fast breakfast at the hotel we packed a lunch and headed for the Napier ranch about 35 miles from town to look for my oryx. Frankly, I wasn't too sure what an orvx looked like. I think that I bought the license for one because Shamsu was dinning in my ear that he could guarantee me one. The license was only \$3, so I said what the hell and bought the extra license. Same for the \$11 eland.

I'd worked my way down the list of animals my license permitted me to shoot. I passed up the cute little dik dik and steinbok because they are so tiny and both live in mated pairs rather than in herds. I'd gotten one tommy, two impala, a waterbuck and one zebra. The license did permit me another tommy, two grants, another waterbuck, a bushbuck, a reedbuck, a couple more zebras, crocodile, wildebeeste and warthog . . . some other time perhaps . . . let's get on to the oryx.

Just after 11 we picked up one of Napier's boys and headed out into the paddocks looking for oryx. He knew right where they were





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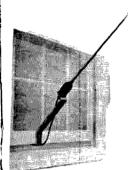
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and we soon spotted them off in a nearby 1000 acre paddock. We had to drive about three miles to find a gate into that area. The oryx caught on right away to us and we could see them off in the far far distance through our glasses. As we drove they kept moving and we didn't get any closer to them. OK, we're not going to be able to approach them in the

Plan two was for Sam, Kibruto (the skinner) and I to hide behind a bush and wait for the oryx while Katimba drove the Rover around the edge of the paddock to keep the oryx moving. This plan broke down right away. We had no sooner gotten settled for our wait when the Rover was in deep mud and just barely able to work its way out. The roads around the paddock were impassable.

OK, plan three. Sam, Kibruto and I set up a blind made out of a couple of dead thorn trees and lav down behind it to watch while Katimba and the Napier boy tried to herd the oryx toward us. We waited about 45 minutes. whispering softly and flicking adventurous ants off our clothes, but no oryx. Katimba returned to tell us that the oryx refused to be herded . . . they just wouldn't pay any attention to them at all. They are probably used to the Africans herding cows and bulls through the paddock.

Plan four next. In this one I was to follow Katimba closely so the oryx wouldn't see me until it was too late. After a mile or two of sneaking along behind Katimba it became obvious to all of us that the oryx had no trouble at all telling the difference between an African and a European at 500 yards. They weren't fooled one bit and they hauled out as soon as I slouched up.

It was after 2 and I was quite ready for lunch. This hiking through thorn bushes is rough. You have to watch every tree closely so you don't get one of those 2" thorns jabbed into you, and they stick out all over. The ground is spread with the thorns too, many of them carefully pointed up to be stepped on. They will go right through most shoe soles and give a nasty infection. In the bogs I had to jump from one grass tuft to the next with memories of all those African movies where fellows disappear in quicksand going through my mind.

A few impala sandwiches washed down by some Schwepps fruit punch called Schwop got me ready for plan five. Africans, by the way, don't each lunch . . . they just squat and talk while the white bwanas eat. Two more Napier boys had joined us by this time so Sam decided that he and I would hide behind a bush in the middle of the paddock and everyone else would try to get the herd moving toward

We picked a nice bush, removed as many of the thorns lying around under it as we could, and settled down to wait, finding a few missed thorns the hard way. There is no position that is comfortable for long and 1 found myself shifting around every few minutes trying to distribute the ache. We could, after a half hour, hear the boys whistling at the oryx, but nothing came in sight. Aha, some horns began to show above the thorn trees not far away ... here they come. I got all ready and aimed carefully where I expected them to come out. A huge animal came out . . . that isn't an oryx, that's a Brahman bull. I wasn't sure what an oryx looked like, but I knew this wasn't it. The oryx went off in another direction while a herd of bulls went past us. We got up, brushed off the ants and made our way to another bush over toward the oryx. Suddenly about twenty of them ran across a clear spot about 150 yards from me. I figured I had about a 50% chance of getting one so I waited. hoping we could get closer. I knew that one shot would be all I would have.

Katimba motioned for me to follow him and we headed off at an angle to the herd and I got set for another try about 500 yards farther on. Just as I was settled down they poured out in the open and I got my first good look at them. I picked out a big one and aimed at his heart . . . wham! The herd took off instantly and mine was down, struggling to get up. I walked in carefully, knowing that these animals can be very dangerous when wounded. They have very long, very sharp horns and know how to use them. A second shot in the neck ended the struggle. I'd gotten my oryx.

Note

I wanted to find out what the reaction was to the first part of this hunting trip in the October issue before I inflicted more on you. The reaction was enthusiastic, hence my continuation this month. There'll be just one more day of hunting to cover next month and then I'll tell you about my visit to the 5Z4 boys and up into Uganda and Tanzania. I also want to give you some thoughts on the prospects for this section of Africa and how this may affect amateur radio.

If you don't get bored, I'd like to tell you about my interesting visits to the other countries in Asia and the South Pacific. I stopped in 26 this trip all told.

. . . Wayne

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73 Magazine

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February 1967

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never say die

Stanford Report

I tried to get a copy of this from Huntoon, but was refused, arousing my suspicions about it a bit. I still remember that lovely report they bought with your money from a public relations firm a couple years back which showed that QST was the only place to advertise and that virtually no ham had ever heard of 73. Fortunately this was so far out that few people paid it any heed.

Well you've spent \$21,000 on another report fellows. The first leak on the report says that they have found that 0.4% of ham operations are on TV and 3% on RTTY. Now you know that I am gung ho on these two modes, but I would never try to fool even the most gullible that there are 400 ham TV stations going or 3000 RTTYers batting it out at any time. Their 36% AM vs 19% SSB will take a lot of explaining to anyone who has operated on the ham bands within the last five years . . . make that ten.

The DXers Magazine

Gus, despite all warnings from friends, has decided to put out a DX magazine. The first issue came out back in September and the magazine has now settled down to an interesting, usually weekly, publication, running about 20 pages. I would say this, if you like to work DX now and then you are missing a lot of the fun if you don't have this little magazine coming in. It costs only \$8.50 a year by first class mail to US, Canada and Mexico. You'll know just what is going on all the time and all the latest scuttle.

Note for authors

Reputable magazines, almost without exception, pay for articles when they accept them for publication. I've been getting more and more complaints from ham authors about not getting payment for articles pub-

lished in other ham magazines. What can we do, they ask. Well, first of all, if I may be sarcastic, be a little more careful where you send your articles in the first place. If, however, you have submitted your article to us and we have, through sheer stupidity, rejected you, then, to get even with us for our denseness, you have forwarded your gem to another magazine and these clouts, after holding it for a year and a half, which, whether you like it or not, is par for the course, you find that you still have not been 'paid on publication" and you don't seem to get answers to your letters asking what is and where is my money then, I suggest, you write an explanatory letter to the post office department of mail fraud explaining the details of this attempt to mulct you through the U.S. mails.

Magazines exist only because they have second class mailing privileges and the appearance of a postal inspector in the publication office is reason enough for several cases of diarrhea, ague, ulcer, and housemaid's knee. I think you'll get the dough pronto. You get it two years or so earlier if you deal with 73 . . . unless we reject you.

Around the world with Wayne

Having worked Rasheed, YK1AA, a couple of times on twenty I was particularly anxious to visit Damascus and say hello to him. Jim (W5PYI) and I drove from Beirut to Damascus in a rented car, detouring for a few hours on the way to see the most remarkable ancient ruins at Baalbek, way out in the hinterlands of Lebanon.

Border crossings in the near east are an adventure. Jim worked the car patiently through the jam of cars while I used every New York subway trick I knew to work my way through the mob of people waving passports, exit forms, entry forms, automobile forms, and money at the nonchalant

(Continued on page 118)

Editor's Ramblings

Paul Franson WAICCH

You probably noticed a few changes when you received this issue of 73. In the first place, we've addressed the magazine on our new IBM data processing system rather than the mimeograph-type stencils we have been using. The IBM system is faster and more legible, and reduces the amount of manual labor involved in processing subscriptions and renewals considerably. We've been growing at an average rate of about 1000 per month for the past year and some, and we were outgrowing the old system. After all the bugs are straightened out, we expect a worthwhile improvement in the speed and ease with which we handle your correspondance.

However, in a change such as this one involving about 50,000 individual addresses, some mistakes are bound to occur. We regret these mistakes and want to get them straightened out quickly. You can help us in this. Please check the address label on your wrapper very carefully. If it contains any errors that might affect your receiving your monthly 73, please send us both the improper label and the correction. It is par-

ticularly important that your zip code be correct. If it isn't the Post Office may not deliver your magazines.

If your address label contains a minor mistake such as a mispelled name or wrong call, we'd appreciate your not asking us to correct it now. The next time you renew or change your address it will be easy to correct, but we'd rather not have to correct these minor things until we've had a chance to cure the more important mistakes.

Another change is that we've switched to a perfect binding. In my editorial in the November 73, I discussed the types of bindings for magazines and their advantages and disadvantages. I made a mistake in one term I used. CQ and QST are side stitched rather than perfect bound. Perfect binding doesn't use staples, so a perfect-bound magazine can be opened fully and it will stay that way. We feel that this binding overcomes the major disadvantages of both side stitching and saddle stitching, and hope you like it.

The third change this month is that we've switched printers. Since the September 1965

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Here's a typical address label. The name comes first. It includes one or two initials, and a last name of up to thirteen letters. Those of you with longer last names are perfectly justified in complaining about machines that don't have human feelings and so forth, but I'm afraid that we won't be able to use your full name. It won't affect delivery anyway. Next is the call. You'll notice that there's something suspicious about this particular one. It's irritating to have your call wrong, but we'd appreciate it if you would wait until you renew to ask us to correct it. It's also won't affect delivery of your magazines. The next line contains the street or box address and the expiration date. The first number indicates the month your subscription expires: I is January, 2 February and so forth up to 9, which is September. O is October, N is November and D is December. The second number gives the year your subscription expires: 7 is 1967, 8 is 1968, 9 is 1969 and so forth. If this space is blank, you have a life or advertiser's subscription, or something else special. The last line of the label gives the town, state and zip code. The zip is very important and must be right. If it's not, please send us both the incorrect label and the correct zip code. Incidentally, if you have an address that requires more than three lines, we can use it but it's not as convenient as the regular three-line address.

(Continued on page 120)

Getting Acquainted with Integrated Circuits

Darrell Thorpe 3110 N. 83rd Street Scottsdale, Arizona

Been looking for some practical general data on using integrated circuits? Here's a short introduction complete with circuits for inexpensive IC's.

If you are going to keep abreast of the most modern solid state circuitry, it's time to start thinking about using linear integrated circuits. Motorola and RCA have recently made available, off distributor shelves, monolithic integrated circuits suitable for operation up to about 100 MHz. And, the best news is that these latest solid state innovations are well within the pocketbook of the average ham. The introductory single piece price of these high frequency devices is in the \$4-5 dollar range. (RCA has just announced a 40% price reduction so the price will be less than listed in the catalog.) RCA is also offering an FM if amplifier limiter integrated circuit containing ten transistors and a voltage regulator for only \$2.00 and an integrated circuit amplifier-discriminator with twelve transistors and regulator for \$2.65.

However, the two circuits that look the most promising for ham use from the price and versatility viewpoint, are the Motorola MC 1550 and the RCA CA 3005. Both of these devices are broadly classified as rf-if amplifiers, and either one is useful at frequencies from dc to beyond 100 MHz. They can be used with an external tuned circuit, transformer, or resistive load in applications

such as:

A-Mixers

B-Wide and narrow band amplifiers (r-f, i-f and video)

C-Oscillators

D-product detectors

E-low-power modulators,

and probably many more with the application of a little ham ingenuity.

I don't wish to leave the impression that the devices mentioned are the only ones available. Similar devices are made by other manufacturers, for example, Westinghouse and Philco, to mention a couple, and also there are a host of other linear integrated circuits broadly classified as de amplifiers,

audio amplifiers and video amplifiers. Fairchild has just announced the availability of the μ A 703 rf amplifier with specification and price in the same range with the Motorola and RCA devices discussed in this article. Moreover, as I will get around to later, some of the low-cost digital integrated circuits can be extremely useful for rf purposes.

Circuit Operation

Now, let's get down to details, first as to what is inside these integrated circuits, how they function, and then, some typical

The MC 1550 and the CA 3005 are quite similar in construction and operation, in that both use a balanced differential amplifier. A simplified schematic that can be used to get familiar with the operation of both integrated circuits are comprised of three devices is shown in Fig. 1. Essentially, these integrated circuits are comprised of three transistors. The current to the emittercoupled differential transistor pair is supplied from a constant current sink transistor.

The voltage V₂ and resistor R₅ establish

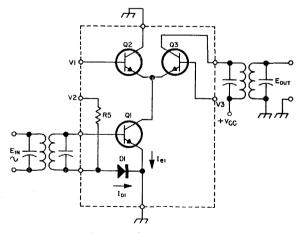
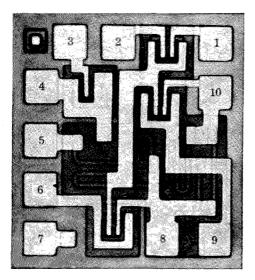


Fig. 1. Simplified schematic diagram of integrated circuit rf-if amplifier.

the current In in diode D1. Since D1 and Q1 are built on a tiny monolithic silicon chip their base-emitter voltage characteristics will be quite similar. Therefore, the emitter current of Q1 will, for all practical purposes, be equal to the diode current. This current established in Q1 will be shared in some manner by Q2 and Q3 depending upon the voltages at V₁ and V₃. If V₁ is at least 114 mV greater than V2, Q3 will not conduct and all the current will flow through Q2 and Q1. Under this condition, the gain of the entire module is at a minimum. However, if V1 is less than V3 by 114 mV or more, all the current will flow through Q3 providing maximum circuit gain. This characteristic should give a hint as to one of the several possible applications of a voltage applied to the base of Q2, i.e., it's a very good point to apply AGC voltage.

Now, let's consider signal operating conditions, the incoming signal is applied to the base of Q1 and the output signal is taken from the collector of Q3. Thus, Q1



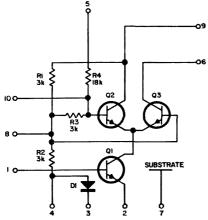


Fig. 2. Schematic diagram and photograph of the Motorola MC 1550. Terminal numbers refer to leads on TO-5 type package.

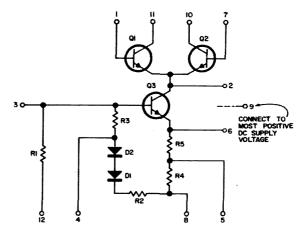


Fig. 3. Schematic diagram of the RCA CA 3005 integrated circuit rf amplifier.

and Q3 are functioning as a common-emitter common-base pair which is better known as a cascode configuration. This configuration has a very distinct advantage because it considerably reduces the internal feedback as compared to a single transistor. The fact that the internal feedback is extremely low means that these circuits (the MC 1550 and CA 3005) are very stable, and you won't have to concern yourself with neutralizing.

Another performance advantage is the AGC capability of these integrated circuit devices as compared to a single transistor. The application of an AGC voltage to Q2 has negligible effect on the operation of Q1, hence, the input characteristics of Q1 remain constant. Thus, there is no detuning of the tuned input circuit with changes in the AGC voltage.

Both the RCA and Motorola circuits can be operated as a differential amplifier with minor external modifications in the wiring. Some of the options of using the cascode configuration or the differential configuration will be covered later.

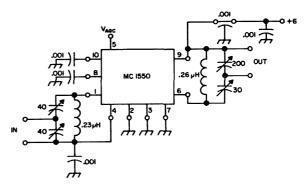


Fig. 4. Typical 50-60 MHz tuned amplifier. Gain is 30 dB with 0 volts AGC and bandwidth is 5 MHz.

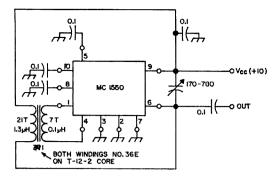


Fig. 5. VFO covering 5 to 10 MHz.

A diagram of the die for the Motorola MC 1550 is shown in Fig. 2. The tiny silicon chip contains the three transistors, four resistors and the diode. Resistors R₁ and R 2 bias D₁, and also provide a base voltage for Q3. The other resistors R₃ and R₄ broaden the AGC voltage range from the previously mentioned 114 mV to about 0.86 volts to reduce susceptibility to noise interference.

The schematic diagram for the RCA CA

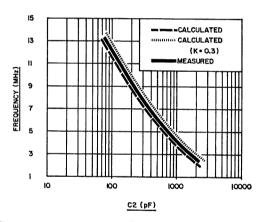


Fig. 6. Frequency vs. Cv.

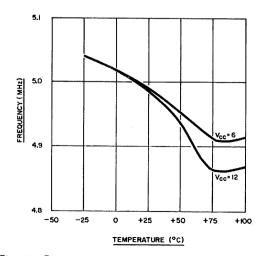


Fig. 7. Frequency vs. temperature.

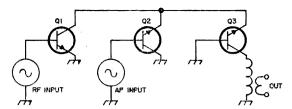


Fig. 8. Simplified model of the MC 1550 used as an rf modulator.

3005 circuit is shown in Fig. 3. While the basic transistor configuration is the same, the biasing arrangement is different and the CA 3005 does not contain the AGC improvement resistors. However, RCA recommends other methods for applying AGC.

Applications

Rf amplifier

Now let's see how these two devices can be applied by the home experimenter. Motorola has built a 60 MHz amplifier using the MC 1550 as shown in Fig. 4. According to Motorola data this amplifier has a gain of 30 dB and a bandwidth of 0.5 MHz. For initial experimentation, adjustment of the input and output trimmers (C₁, C₂, C₃ and C₄) should easily move this amplifier to six meters.

Another Motorola circuit employing the MC 1550 is a VFO covering 5 to 10 MHz. This circuit is shown in Figure 5. Data illustrating the performance of this oscillator is given in Fig. 6 and 7.

The excellent AGC characteristics discussed earlier, makes the MC 1550 very useful as an amplitude modulator. A simplified diagram of a typical low power modulator is shown in Fig. 8. By injecting an audio signal to the base of Q2 and an RF signal at the base of Q1, the rf will be amplified by Q3 as a function of the audio input. Remember earlier when it was discussed how the gain of Q3 varied from

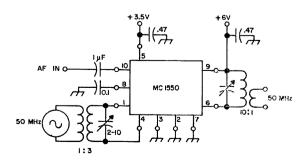
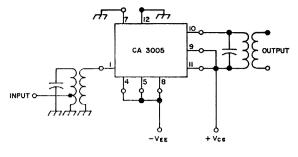
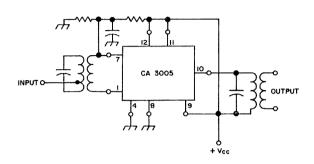


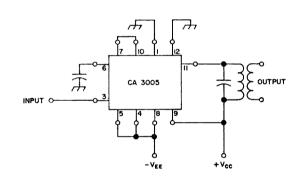
Fig. 9. Low power modulator circuit for 50 MHz.



DIFFERENTIAL-AMPLIFIER CONFIGURATION OPERATED FROM A DUAL SUPPLY (A)



DIFFERENTIAL-AMPLIFIER CONFIGURATION OPERATED (B) FROM A SINGLE SUPPLY



CASCODE - AMPLIFIER CONFIGURATION OPERATED FROM A DUAL SUPPLY (C)

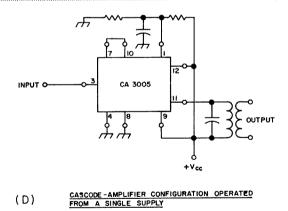
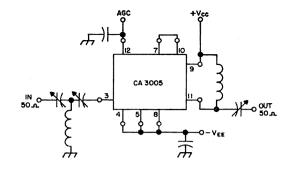


Fig. 10. Supply connections for the CA 3005 integrated circuit amplifier. A. Differential amplifier configuration operated from a dual supply. B. Differential amplifier configuration operated from a single supply. C. Cascade amplifier configuration operated from a dual supply. D. Cascade amplifier configuration operated from a single supply.



DC SUPPLIES	POWER G	POWER GAIN (dB)	
VEE & VCC	30 MHz	100 MHz	
± 6V	36.0	20.0	
±4.5V	33.0	18.5	
±3V	22.0	15.0	

Fig. 11. Typical power gain performance of a cascade configuration at various supply voltages.

minimum to maximum with the bias voltage applied to Q2? This circuit yields excellent modulation characteristics with about 90% modulation, both up and down, easily achieved with very low distortion.

A 50 MHz modulator is shown in Fig. 9. This typical circuit should spark ideas for other modulation applications, for example, the previously described oscillator or oscillators at other frequencies could easily be modulated to provide a signal generator or even a low-low power transmitter.

The CA 3005

Now let's take a look at some of the circuits RCA proposes for their versatile CA 3005 integrated circuit.

The CA 3005 can be operated at various levels of supply voltage from 3 to 9 volts and from single or dual dc power sources. Fig. 10 shows the various methods of connecting supply voltages for both the differential and cascode amplifier configuration and for single and dual supplies. Fewer

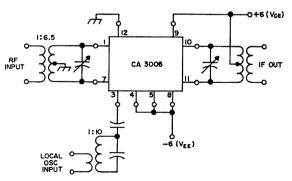


Fig. 12. Typical circuit diagram using the CA 3005 as a mixer.

(D)

external components are needed with the dual supply. To clarify what is meant by a dual supply, take the case of operation from 9 volts. Two nine volts batteries are needed, one for the positive supply Vcc, the other for the negative supply Vee. The other terminal of both batteries is grounded. Notice that when only one supply is used, an external voltage divider and by-pass capacitor is needed for the CA 3005. The MC 1550 has this voltage divider built in the circuit.

The circuits in Fig. 11 illustrate what you can expect from the CA 3005 operating as an rf or if amplifier at 30 MHz and 100 MHz from several supply voltages. Of course, several of these integrated amplifiers can be cascaded to provide additional gain. However, the CA 3004 which has emitter resistors that provide increased signal handling capabilities is recommended in place of the CA 3005 when several stages of if amplification are needed.

Mixer applications

The CA 3005 integrated circuit can also be used as a mixer converter, low power modulator and as a product detector. A typical example of a mixer application is shown in Fig. 12. The local oscillator signal is applied to the base of Q3 and the rf signal is applied either single-ended or double ended to the bases of transistors Q1 and Q2. A mixer-oscillator combination, which could be considered as a complete front-end on a single chip, is shown in Fig. 13.

Using digital circuits in rf applications

The Fairchild μ L 914, which is a dual gate logic circuit, is of particular interest for *rf-if* circuitry. This epoxy device costs

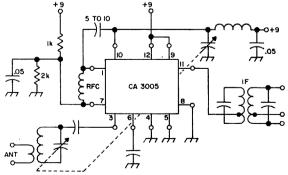


Fig. 13. CA 3005 can function as a complete front end. Part of the circuit acts as a mixer and the other parts as a local oscillator.

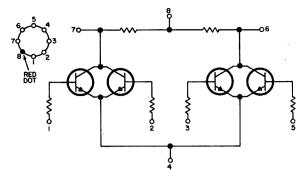


Fig. 14. Schematic diagram of the Fairchild μ L 914 dual gate logic integrated circuit.

only 80 cents and prices are still going down. For this meager sum, you receive the equivalent of four transistor and six resistors. However, for the rf-if applications, you can only use two of the transistors. The complete schematic for the µL 914 is shown in Fig. 14. The 914 can be used at frequencies up to about 20 MHz. At 10 MHz the gain is about 30 dB falling off at frequencies above 10 MHz. Note in the typical circuit shown in Fig. 14 that AGC can be applied giving excellent gain control. Another point to note, also, is that the 914 can handle inputs of about 150 mV or less. Greater signal voltages will cause limiting, hence, the 914 also makes an excellent FM-if limiter.

With this broad introduction to the Motorola MC 1550, the RCA CA 3005 and the Fairchild μ L 914, integrated circuits and the typical application examples, I am sure that many of you will soon be plugging them into sockets. And, before long, there will be construction articles for converters, receivers and even QRP transmitters

. . .Thorpe

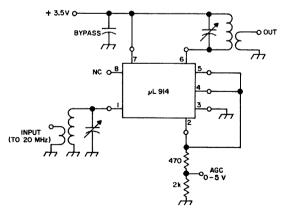


Fig. 15. Fairchild μ L 914 shown in a typical rf-if circuit. Input signals up to 20 MHz and levels up to 150 mV can be handled by this device.

Using Low Cost FET's on Six

The new Texas Instruments TIM12 field effect transistor is excellent for 50 MHz use, yet costs only \$1 in small quantity.

Field effect transistors (FET) seem to be the answer to converter design for the 50 MHz amateur band. The cross-modulation problems common with ordinary transistors and even with tubes are no longer a real headache when using these new transistors. Ordinary transistors are subject to overload and cross-modulation with more than about 20 millivolts input which means that local stations can ride in on weaker signals anywhere in the amateur band. An rf stage ahead of the mixer even with tubes (less overload characteristics) will usually amplify a local station 100 KHz or so away from the desired signal enough to crossmodulate it in the mixer stage. FET types of transistors as mixers have extremely good characteristics for reducing cross-modulation and will even permit the use of an rf amplifier in most locations. Ordinary transistors and even some tube mixer types will often overload enough with an rf stage circuit to make them useless in some locations.

The FET units have been expensive for use in the vhf region and often have exhibited poor noise figure values. The writer recently obtained some new FET plastic-cased transistors for approximately one dollar apiece from a Texas Instrument distributor. These were TIM12 units which have very low NF and good gain values at 50 MHz. A circuit of a good 50-MHz converter is shown in Fig. 1 and illustrated in the photographs. The converter was built on a scrap piece of copper-plated board

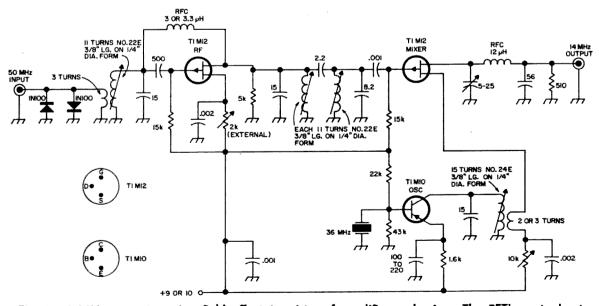
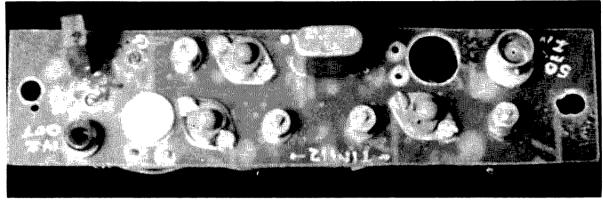


Fig. 1. 50 MHz converter using field effect transistor of amplifier and mixer. The FET's cost about \$1 each. This converter has a noise figure of around 2 dB and great resistance to cross-modulation.



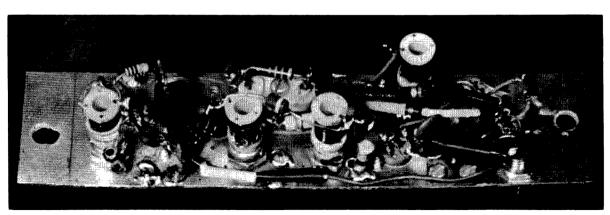
Top view of W6AJF's six meter FET converter. The extra hole by the BNC input jack was used for neutralizing trimmer that proved unnecessary.

1½ x 6 inches for mounting into a 6 inch wide aluminum chassis. The noise figure measurement between 50 and 52 MHz was from 1.5 to 2.5 dB. This is very low and means that in nearly all locations, antenna noise pick-up will completely override the receiver noise.

The cross-modulation capability was checked by connecting two signal generators to the input jack. One signal generator was connected to the converter input thru a 10 dB pad and, with no modulation, was set to give an S5 or S6 signal reading in the if receiver when the whole system was tuned to this signal frequency. Then another tone modulated signal generator was turned on at about 1 MHz off frequency (connected directly to the converter) and its output attenuator adjusted until some over-riding tone modulation was heard on the cw signal generator. It took more tone signal than could be obtained thru the attenuator which was supposed to have 100,000 microvolts maximum output. The "one volt" output jack produced appreciable cross modulation. It was estimated

that it took about 1/4 volt to produce objectionable cross-modulation. It was necessary to have a large resistor pad between the converter and the if receiver, and to have the two test signals separated far enough apart so the cross modulation problems in the if receiver were negligible. It is surprising how poor some homemade and some commercial radio receivers are for cross modulation in the 14 MHz region. It would seem that FET transistors should be used in all 14 to 18 MHz and 5 or 2 MHz if and mixer stages right up to the main sharp mechanical or crystal filter in the if section. A 20 dB pad on the if receiver input helped to reduce these effects while trying to check the converter only. The added pad or attenuator was only a stopgap cure since the real cure is to use a better designed if receiver.

Surprisingly, the IN100 back-to-back diodes in the receiver input were not trouble-some in these cross-modulation tests. These diodes are standard on all my converter inputs in order to provide some transistor protection from moderately high powered



Bottom view of the low noise, low cross-modulation FET converter. The copper shield is across the rf amplifier socket. The solenoid rf choke at the other end is part of the pi network output circuit.

transmitters at this station. The 1N100 diodes have a low capacitance, reasonably high back resistance and quite low forward resistance and are low cost types. Connected across the coax input jack, the diode loss is very low and it does provide some added protection against destructive surge voltages from the antenna system or switching relay.

The converter rf stage required some neutralization by means of a 3 or 3.3 microhenry rf choke connected between the input and output tuned circuits. This resonates roughly at 50 MHz with the gate to drain capacitance of a TIM12 which is typically about 3 pF. Even with this amount of inductive neutralization it was necessary to load the tuned input circuit down to quite a bit less than 1000 ohms by means of the antenna link of three turns. The FET has high input and output impedance and a 5000 ohm resistor across the output tuned circuit was also needed. A variable source resistor of 2000 ohms was mounted external to the converter to permit easy rf gain adjustment.

The FET mixer stage in this unit has gate signal input and source oscillator injection. A small Trimpot, 0 to 10,000 ohms, provides bias for the mixer stage. This pot and the oscillator pick-up link of 2 to 3 turns were adjusted to provide minimum cross-modulation effects. Actually a $2-k\Omega$ or $3-k\Omega$ fixed resistor would be quite satisfactory for this type of transistor and oscillator injection voltage. The latter is greater than with ordinary transistor mixers, but should be a little less than that which gives

maximum mixer gain. At the maximum gain value, the cross-modulation effects are worse. The mixer output circuit is a pi coupling network tuned to about 15 MHz. The dc path resistor across the output jack can be made much lower in value if a wider if frequency response is needed. The value will be somewhere between 50 and 500 ohms for most if receivers. If the latter actually looks like 50 to 70 ohms, the dc shunt resistor can be of a higher value.

The 36 MHz crystal oscillator uses a TIM10 or any other VHF transistor which will produce strong 36 MHz output with one or two milliamperes of collector current. The emitter bypass capacitor produces regeneration and its value will usually range between 100 pF and 220 or even more for most types of PNP transistors. The FET TIM12 units are P-channel which is similar to PNP transistors for battery supply polarity. Some FET units are N-channel which require the same supply voltage polarity as NPN transistors. The TIM12 has an odd base arrangement of leads (see Fig.1) as compared to ordinary transistors. This can cause some confusion in wiring up the transistor sockets and requires a little care in checking over the circuit wiring before fixing up the converter.

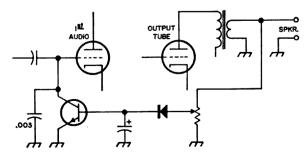
As a final comment, this converter showed a 25 to 30 dB improvement in cross-modulation as compared to several other 50 MHz converters using ordinary vhf transistors of several types. It also had a better NF than the other converters. The spurious signal responses were less due to the FET mixer.

. . . W6AJF

Simple Audio-Derived AGC

I don't claim originality for the basic idea here. Obtaining AGC voltage from the audio output is as old as audio output. The schematic tells most of the story; it will help others equip their receivers with effective AGC from junk box parts with only one internal connection. The transistor is not critical, although it must be NPN silicon (high collector to emitter resistance with no signal or small signal). I've tried about fifteen, from 2N33, 497, 2195 to 2N????, and they all work. The variable resistor can be anything over 50 ohms; I used 10 kilohms, and an audio taper is better than linear. Diode—any germanium: 1N34, 1N277, etc. Base capacitor will de-

pend on each operator's taste on delay time. $40~\mu F$ works fine. The circuit provides fast attack and on three receivers has given an average of 30 dB compression with the pot at maximum. Receiver volume control should be set for loudness with minimum signal and maximum is set with the AGC pot. . . . N. H. Chamion W6BGQ



Low Cross-Modulation at 144 MHz

The biggest culprit in most cases of cross-modulation is the mixer. In the converter described in this article, W6AJF uses a low cost FET for the mixer, which gives low cross-modulation, and a low cost VHF transistor for the rf stage, for low noise figure.

The 144 MHz band sometimes has enough nearby stations to cause trouble in receiving on this band. Very strong local or line-ofsight transmitters can overload the usual transistor converter and ride in on top of the desired signals even though far enough removed in frequency so the selectivity of the main if system should eliminate this effect. Usually the trouble can be traced to the converter transistor mixer stage since perhaps 20 millivolts of signal will produce cross-modulation on top of the desired signal. The answer in most cases is to use an FET type as the mixer since it takes ten to twenty times as much input to show cross modulation. FET devices are usually better than nearly any type of tube mixer at vhf.

FET (field effect transistors) have been very expensive in the past but now some are in the one dollar class such as the TIM12, a plastic-cased transistor. It works very well as a mixer at 144 MHz but is not too good as an rf stage. The converter shown in the photographs and in the circuit diagram was originally built with two FET TIM12's in it, one as the rf stage and the other as the mixer. The noise figure measured about 5 dB which isn't bad for average local station reception but isn't good enough for 144 MHz dx signal reception. The TIM12 is a p-channel germanium FET unit sold by Texas Instrument distributors for \$1.07 at the time the writer

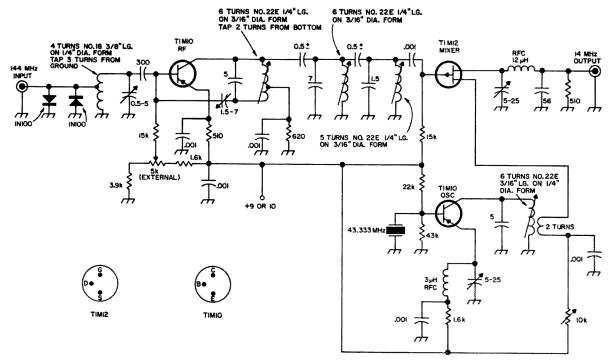
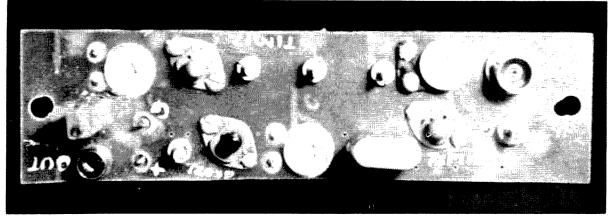


Fig. 1. Schematic of W6AJF's low cost, low noise, low cross-modulation, two meter converter. Note that only the mixer uses an FET; the mixer is responsible for most cross-modulation.

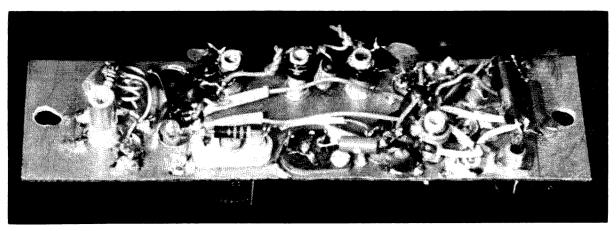


Top view of the converter described in this article. It's built on a $1\frac{1}{2}$ " x 6" piece of copper-clad board. The copper is on the underside.

obtained a few. The rf gain and NF varied greatly at 144 MHz though these same units gave excellent results at 50 MHz in an rf stage. Apparently at 144 MHz the TIS34 FET (at 4 times the price) would be needed and it is an N-channel silicon transistor requiring a change in battery supply polarity.

It was decided to use a neutralized TIM10 vhf transistor (approximately 50 cents) in the rf stage, and oscillator, and the lowprived FET as the mixer. The resulting circuit is shown in Fig. 1. The NF measured at 2 to 3 dB which is fine for dx reception. Two 144 MHz signal generators were connected together thru a 10 dB pad (50 ohms) and the tone modulated generator also tied into the converter directly. The unmodulated signal generator was adjusted to 145 MHz and its output attenuator set to give an S-6 signal into the converter and if system. The tone modulated signal generator was then set to 144 or 146 MHz and its output increased until some tone could be heard riding in on top of the "cw" signal at 145 MHz. With maximum rf stage gain and maximum mixer gain, it took about 25,000 microvolts to cross modulate the S-6 desired "cw" signal. By increasing the mixer source variable resistor to 2-kΩ ro 3-kΩ the "tone" signal had to be increased to 50,000 μ V or 50 millivolts. If a local signal is greater than that, some benefit can be obtained by using forward gain control on the rf stage. For extreme cases of cross modulation, a TIS34 N-channel FET stage (neutralized) would be desirable in place of the PNP ordinary TIM10 transistor.

Just changing the mixer stage from a TIM10 or other types of vhf transistors, to a FET mixer such as a TIM12, improves the cross modulation characteristic by at least 20 dB. The 50 MHz converter shown in the May '66 issue of 73 Magazine and the 144 MHz converter in the June '66 issue were modified to use the FET mixers only. Type TIM12 FET units look like the TIM10 ordinary units but have a different basing



Bottom view of the converter. The "gimmick" capacitors between the three tuned circuits are about 1/2 pF apiece. They should be adjusted for best coverage of 144 to 148 MHz.

arrangement as shown in the new circuit diagram. The 10-KΩ variable source resistor was not used in these modifications. Only the fixed 3.3 kΩ former emitter resistor was used in the source lead with an .001 μF bypass and two turn pick-up link to the oscillator coil. The gate is a fairly high impedance even at 144 MHz, so should be connected to the top of the tuned circuit instead of thru a one turn link as with an ordinary transistor mixer. Note that the FET unit only requires one resistor to the plus supply voltage rather than the voltage divider normally used with ordinary transistors.

The overtone crystal oscillator uses a low-O emitter circuit tuned above the fundamental frequency of the crystal (about 14½) MHz). This emitter circuit has to be tuned below the overtone frequency of 431/3 MHz. Too low a LC ratio, at perhaps 25 or 30 MHz, may not give enough regeneration at the 130 MHz collector frequency with some transistors to give good output power at 130 MHz. The TIXM05 crystal oscillator functions very well with a 5-25 pF adjustable ceramic capacitor and a 3 µH rfc. The TIM10 is a little marginal with these values and perhaps a 4 µH rfc and smaller capacitor might be better. The proper values are those which provide a very weak 431/3 MHz oscillation at the overtone crystal frequency and doubling or tripling power to the desired output frequency in the collector to emitter system. Low rf power oscillation at 431/3 MHz should mean low rf crystal current with attendant high frequency stability. However, the transistor has to oscillate at 431/3 MHz and efficiently triple to 130 MHz. Regeneration at 130 MHz helps increase the 130 MHz power output without running much rf at 431/3. These oscillators, where one does the work of two, can be made more stable in frequency but do require some experimenting to get them to work with each change in transistor type. The writer has never had any difficulty with their use over long periods of time, but does sometimes have to work on a particular converter to get it into reliable oscillation the first time it is tested. The 3 microhenry coil can be wound from coil table or calculator data. or it can be a commercially made small encapsuled rf choke. If one doesn't work, don't be afraid to try another one as the tolerance on some rf chokes is awfully wide. Actually, a ferrite-cored rf choke of 3 or 4 micorhenrys will have a higher Q than "air wound" varieties and produce oscillation more easily. The unloaded Q of this coil should be at least 15, with higher values being desirable. The transistor should be a type with good vhf gain and a cut-off frequency of at least six times the overtone crystal frequency, and a few times the harmonic frequency desired. Like most harmonic generators, the second harmonic is upwards of twice the value as for the third harmonic. The fourth harmonic is usually too low in amplitude to be used in vhf converters.

... W6AJF

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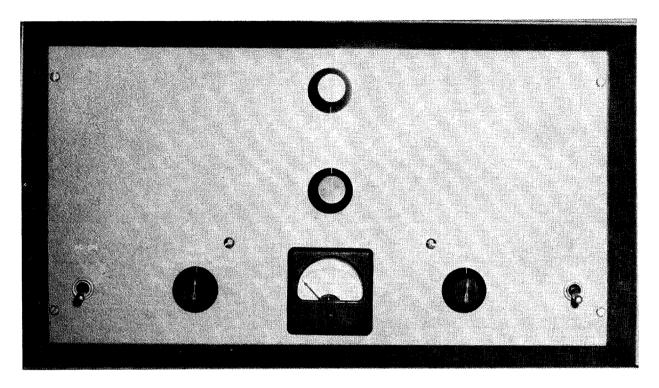
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The 30P1 Linear Amplifier -A Peasant's 30L1

The commercial trend toward smaller and lighter equipment has been only slightly followed by the home builder. The reasons are many. The newer smaller components are expensive, difficult to obtain in some cases, and of course one has to make use of all the goodies present in the junk box, and of the surplus bargains.

The amplifier described here was planned to be as small as possible, yet provide kW, or near kW power. It offers nothing new in circuitry, being the standard 811A rig already described many times in all the amateur publications¹. The only thing different is the packaging. It proves that the proper selection of components, layout planning, and the use of the BIG parts press will result in a smaller piece of equipment of comparable power than usually comes out of the home workshop. All without requiring an elaborate machine shop and using all readily available parts.

The whole thing is squinched into a Bud SB-2142 Shadow Box cabinet, measuring 17 x 11 x 9½ inches, and weighs 57 pounds. Squinched—Lowenbrau inspired contraction of squeeze and pinch). While few of the components are of the junk box variety, all of them are readily available and will present no problem. The total investment on my part was \$80, but this was greatly reduced since the pwwer transformer was on hand. If a similar transformer is available, the amplifier can be duplicated for roughly the same amount.

An explanation of the name is in order. Other than being a take-off on the well known amplifiers, it goes back to my Greenville, S. C. days. When I graduated to a 4-1000A, I proclaimed loud and often to my 811A operating friends that 'any ole peasant can run 811's. Hence the '30 Peasant 1'.

1. For instance, March 1962, page 33.

The circuit: As already stated, nothing new or unusual is claimed for the circuit, and space will not be wasted to show a schematic that can be found in back issues. It is a standard grounded grid, cathode driven pi-net output configuration. The power supply shown provides 1520 Vdc, while 4.5 volts negative bias is furnished by a filament transformer supply. The Barker and Williamson 851 pi-net tank is used in the output circuit, with added contacts being used to switch in added capacitance for loading on 75/80 meters only. Metering is provided in the grid and cathode circuits, as well as an rf voltmeter which provides relative power output indication.

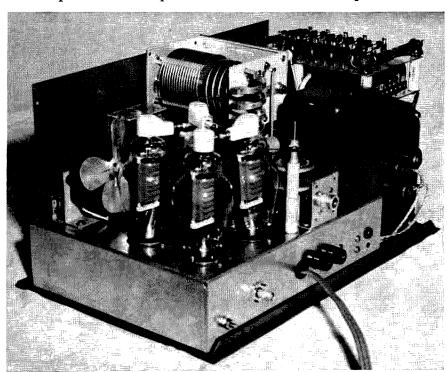
The power supply: As already mentioned, the power supply delivers 1520 volts with the transformer used. It is a full wave circuit, using nine 750 mA 600 piv silicon rectifiers in each leg. The particular rectifiers used here were obtained from Barry Radio in New York, and sold for 36c. There are many bargain counter type rectifiers on the market today, though many turn out to be the bargains they appear. These silicons from Barry have been used in a number of my projects and I recommend them unconditionally. Negative lead filtering is used, mainly to reduce the required voltage, insulation and physical size of the choke. Four 100 µF/525 volt paper filter capacitors are used in series. The resulting 25 µF at 2100 working volts maintain a fairly constant output voltage. These capacitors are

shunted with 100 $K\Omega$ 2 watt resistors to equalize the voltage drop across each individual unit.

Fuses are used in the primary of the high voltage transformer as well as in the B+ line itself. The latter is a Buss High Voltage HVB type, rated at ½ amp. These particular fuses are manufacturer rated to carry up to 135 per cent load. The ½ amp size used here seems the best choice to protect the particular rectifiers used.

The rectifier and filter assembly is made up of two similar pieces of lucite, supported and separated by 1¼ inch steatite spacers. Right angle brackets hold the entire assembly on top of the power transformer. One-half inch screw-type standoff insulators are mounted on the top piece to support the rectifiers, paralleling resistors, and also the current limiting resistors. The high-voltage fuse holding clips are also mounted on the top piece, toward the back so it can be accessible by removing the back cover of the cabinet.

Construction: A few words now concerning the sheet metal work involved. The Bud cabinet used comes apart in four pieces; top and sides together, front, back, and bottom. This is an ideal setup since components can be mounted directly to the bottom and the rest of the cabinet built up around it. One drawback is the fact that the cabinet is made of steel, and is difficult to work, but the small number of holes required makes this a minor problem. The



Back view of the linear with the power supply in place.

meter hole was cut with a Sears and Roebuck adjustable hole cutter which, with plenty of oil went through with no trouble without burning up the cutter blade.

A hint of the use of such cutters: Remove the ¼ inch pilot drill and replace with a short piece of ¼ inch shaft material. Drill a % inch hole in the panel and install a ¼ inch inside diameter panel bushing for the shaft to ride in. After centering the work carefully, clamp securely to the drill press table and feed slowly. In the case of steel panels, oil should be applied steadily as the cut deepens. Oil is not required while cutting aluminum, although it should be used in the panel bushing at all times. In the latter case. cutting should be stopped periodically to remove the buildup of material that accumulates on the cutter blade, insuring a clean cut.

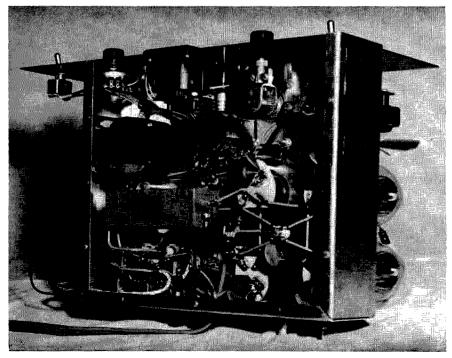
The power transformer is mounted directly to the cabinet bottom using rubber feet on the outside. This provides firm support for the transformer. Rubber feet are also installed on the opposite end of the bottom in the opposite locations used to mount the transformer. The chassis is a Bud AC-418 17 x 12 x 3 inches, cut down to 10 x 12 x 3 inches. The resulting open end is placed against the front panel and secured with threaded right angle brackets.

To provide ventilation, the solid back provided with the cabinet was discarded and replaced with a like-size piece of Reynolds perforated aluminum. Also, three 1-inch holes were punched in the forward edge of the sides, and 'C & G' 1-inch perforated ventilating hole plugs were installed.

Tank coil and plate tuning capacitor are mounted on a bracket made from 3/32 inch aluminum and really serves two purposes. Primarily it supports the coil and capacitor, but it also provides a mount for the bleeder resistors and a heat sink of sorts to help dissipate the heat generated by them.

The B & W coil was modified by the addition of an extra set of contacts to the switch on the back, to switch in a 1000 pF/-1250 volt mica capacitor for loading in the 75/80 meter band. The contacts are installed in the normally blank position, and further modification is required to the detent plate on the front of the coil assembly. This modification consists of drilling a hole for the spring-loaded ball bearing to drop in and hold the shaft in the proper position. A quick look at the coil, switch, and detent plate will readily clear up any vague points. Extra switch contacts can be obtained from Barker & Williamson, Inc. for \$1.00. Don't forget to mention the type of coil.

The plate loading variable capacitor is a broadcast type triple 420 pF unit, also from Barry Radio. It is mounted vertically against the chassis and driven through a National 'RAD' right angle drive. This method of mounting was used to permit a short RF ground path, a short connection to the output side of the pi-net coil, and also because the darn thing was too long to mount any other way. Actually, it is efficient for the



Bottom view of the 811A linear described in the text. This is the rf section; the power supply fits in the space at the left.

reasons mentioned, and helps to maintain a symmetrical front panel.

The ten meter portion of the coil is removed from its original mounting, the ends rebent, and placed as seen in the accompanying photographs. Two Centralab 858S 1000 pF 5 kV capacitors are used for plate coupling and mounted directly on the ten meter coil. Copper strap ½ inch wide is used for all plate circuit connections.

Due to the height of the tubes, the sockets have to be submounted. A 11/2 inch socket punch is used to cut clearance holes for the tube bases, and also for the Millen R-175A plate choke. The Johnson 122-224 sockets used for the 811's are mounted on 11/4 inch spacers. The base provided with the choke is removed and the choke is mounted directly to a 1/8 inch thick phenolic rectangle mounted on the inner tube socket mounting screws. This can be seen in the accompanying bottom view photographs. The B & W FC-15 filament choke is mounted under the chassis on 1 inch standoff insulators to clear the high-voltage line running from a feedthrough insulator close to the edge of the chassis, to the rf choke, and to the choke by-pass capacitor. Also, mounting the filament choke at this height puts its terminals at the same level as the tube connections. resulting in shorter leads.

Suggested changes: Bias. As originally built, the 811's are not cut off during standby periods, and the resulting plate dissipation makes the whole thing run a wee bit on the warm side. I recommend a higher voltage bias supply, with external switching thru the vox circuits, to apply cutoff bias during standby periods, applying operating

bias as drive is applied.

Fan: The fan used does an adequate job, though since building this I have discovered the Rotron muffin fans, and their newer Skipper fans. I used the former, and recommend them for this or any similar applications. They are small, death quiet, and the amount of air they move has to be felt to be believed. They are almost as windy as some 75 meter operators.

The filter/rectifier sandwich should be changed to a triple-decker. The top, or added section, would be a similar size piece of lucite mounted on proper height spacers to clear the components already mounted. This is for safety reasons only as the exposed high-voltage could result in a shocking situation during the initial cover-off smoke test.

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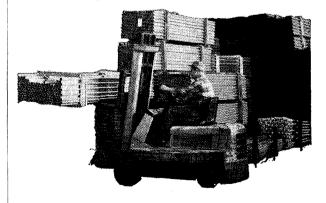
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Many UHF converters suffer from lack of local injection. W60SA seems to have solved this problem in his converter. Maybe you could use his arrangement.

An Improved Multiplier for UHF

Les Maurer W60\$A 209 Nob Hill Way Los Gatos, Calif.

It seems to the writer that every UHF converter he builds up with the same basic deficiency—marginal crystal current through the mixer diode. This deficiency in turn has always been traced to the same cause—low output from the last tube in the multiplier string.

Maybe this is because I operate my multiplier tubes at their rated input while other builders follow the good old California custom of doubling the manufacturer's recommended plate voltage. Or maybe I am just a careless builder.

After putting up with this nonsense for a couple of years it was decided to grip the bull by the horns and construct a souped up multiplier string. The next question was how to soup it up without turning it into a transmitter. Remembering K1CLL's article on neutralizing receiving type tubes in the August 1965 73, it was decided to try a 6AK5 straight through amplifier at the 3F point in the chain (141 MHz in this case).

The old multiplier string was modified to look like Fig. 1. Following KICLL's advice, the 6AK5 amplifier was first tried without neutralization, and as usual, no luck. Next, we added the neutralizing loop and two twists of hook-up wire for Cn. Got the loop backwards the first time as predicted. Reversed the loop and "Voila" about ½ watt of stable rf energy at 141 MHz. How do

I know it is watt? Well, it lights an NE 52 neon bulb if you touch the tip on the tank coil. Also, be it noted, the light goes out when you pull the crystal out of its socket, which it did not do prior to neutralization.

The writer uses the unit in Fig. 1 to drive a Raytheon 5656 dual tetrode operating as a push-pull tripler to 423 MHz. The 5656 has recently turned up in surplus houses at about \$2.50 and is indeed a nifty UHF low power multiplier or amplifier. It appears to put out about 1/2 watt at 423 when used as a tripler. The writer used the plate lines out of an old APS 13 oscillator, 1/4 wave at 423 MHz and a 4 turn grid coil resonant at 141 MHz and link coupled to the preceding unit (Fig. 1). The output of the 5656 is link coupled through the original APS 13 link to a varactor multiplier in my K6AXN/ W6AIF mixer box which is tuned to 1296 MHz. This produces 350 µA of crystal current in the 1296 MHz mixer diode (1N21C) even when very loosely coupled and with the 5656 running cool (140 volts on plate).

In addition to now having all the mixer current I can use, there is an added bonus, (where did all the birdies go?). Apparently, as a result of inserting the straight through amplifier and the addition of three more tuned circuits followed by a push-pull tripler in place of the old single ended stage; all the birdies which normally wend their way

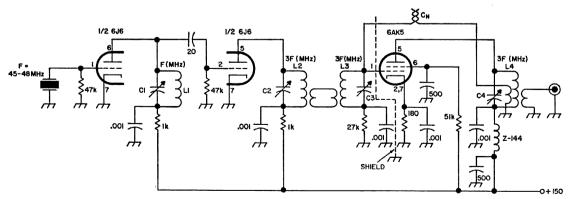


Fig. 1. Low power exciter-local oscillator. Output is in the 140 MHz range for use as local injection in a 1296 MHz converter.

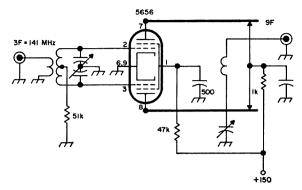


Fig. 2. Tripler from 141 to 423 MHz. This circuit uses the plate lines from the old APS 13.

up the multiplier string were knocked out. This in itself would probably justify the effort.

It appears that commercial designers of military equipment (not ham equipment) feel that the use of push-pull triplers and link coupled straight amplifiers in a local oscillator chain is good practice. I have since discovered that the LO chain in the AN/FRC-34 1800 to 2000 MHz receiver, built by GE, has almost the same arrangement. They went a little overboard on power. The FRC-34 has an 832A where I have the 6AK5* and a 2C39 where I use the 5656. Who needs a transmitter? Just modulate your LO, provided it's in the band.

As a matter of fact, the 6J6-6AK5 unit would make a neat flea power two meter rig. All that is needed is a suitable crystal, like 48.4 MHz for instance, and a 6AK6 modulator driven by a carbon mike.

With regard to tube substitutions, the 12AT7 could be used in place of the 6J6 if desired. I can't think of a substitute for the 6AK5 off hand, but show me the UHF ex-

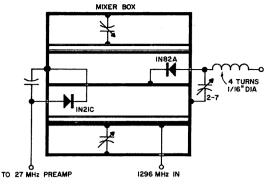


Fig. 3. 1296 MHz converter front end. Input at right is 423 MHz from the tripler in Fig. 2.

perimenter who doesn't have a few in his junk box and I'll send him a couple. The 5656 is a little more of a problem. A pair of 6J4's would also work. These little tubes have turned up in the surplus around here for as little as fifty cents a piece. They are outmoded as receiver amplifiers but still look mighty good as low power frequency multipliers up to at least 450 MHz. Check the Cm in your tube manual. There is the added advantage that if the APS-13 transmitter box is used, the 6J4's would plug into the 7 pin miniature sockets already there with only minor changes in the pin connections.

One final picce of advice with regard to the 1N82A varactor multiplier, I had all kinds of trouble driving these things until I tried the "L" network out of the ARRL VHF Handbook (see Fig. 3). Since that time, no more trouble has been experienced in getting the drive out of the 423 MHz tank and over to the place where it is needed on the ungrounded end of the varactor.

. , . W60SA

Measure Relative Power and Plate Current

A relative power meter on a sideband transmitter or transceiver is quite useful in tuning for maximum output, but at times it is helpful to know the final plate current.

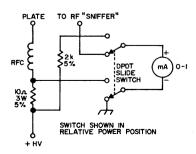
The circuit shown has been used on an HX-20 and has proved quite useful as a check on operating conditions, as well as an indication of power input. With the resistors used and the 0-1 mA meter switched, full scale deflection is approximately 200 mA. Be sure to insulate the meter and switch for full plate voltage.

The desire for a plate current meter arose upon changing the final tube to a

6146-B and increasing the plate voltage to 750 volts in an effort to obtain maximum drive for a linear amplifier.

Only a minimum of time and parts are required to install the above circuit and it is well worth the effort if it saves a final tube from going bad.

. . Carl Pleasant W5MPX



A Broad Band 80 Meter Vertical

Tired of narrow band antennas that have to be retuned when you change from CW to SSB? Here's an antenna that covers the whole 3.5 to 4.0 MHz band without any adjustments.

Being an advocate of DX and contests, most of my operating time is spent on 20, 15 or 10 meters, but there is the odd time that the urge hits me to try 80 and 40, especially during an all-band type of contest. Unfortunately the usual type of array which one finds on 20 meters and higher is in most cases impractical on the low bands because of size and cost. In order to get the necessary low angle of radiation so necessary for DX, the most logical type of antenna to choose is the vertical, but even this becomes a bit formidable when

Fig. 1. Basic configuration of VEITG's broadband 80 meter vertical. The idea is old, but it works well.

one gets down to 3.5 megahertz.

My old reliable antenna for 80 was the familiar inverted V, or drooping dipole, which has served me well in many different places. The same goes for 40, but having finally landed in a fairly permanent QTH it seemed the time had arrived for a more serious effort.

As far as 80 was concerned, the major requirements of the antenna were:

- 1. Simplicity and ease of construction.
- 2. Low cost.
- 3. Low angle of radiation for DX work.
- 4. Broad band of operation to cover both 3.5 CW and 3.7 to 3.8 SSB.
- 5. Coax feed.

Considerable thought was given to the usual ground plane type of array, but considering the heights involved, this was discarded in favour of the vertical quarter wave with radials on the ground. As will be seen, the actual result was quite a departure from the usual single vertical radiator. Fig. 1 shows the complete design of the antenna in its final form. The main support of the antenna is a 50 foot wooden A frame. Six lengths of wire are cut. The longest is 66 feet, and each other wire is one foot less, with the shortest being 61 feet. The upper ends of the wires are well soldered in parallel, and are mounted to the top of the A frame by whatever means is convenient. In my case I used a stainless steel strap which encircled the top of the mast, and to which a large cable clamp was bolted. The wires were then soldered to the clamp.

At a point about two-thirds down the length of the wires, an insulator is fastened, and by using ropes or other suitable strong

lines, the six wires not only act as radiators but also as guy wires. Note from Fig. 2, that the wires are merely looped through the holes in one end of the insulators and then carry on down to the base of the A frame. At this point, all six wires are again soldered together and fastened to the mast by the use of a stand-off insulator. Now when the guy ropes are pulled tight, the antenna becomes a conical shaped multielement vertical. Because each wire is a different length, and each length is resonant at some point in the 80 meter band (1/4 wave) the antenna as a whole is broadly resonant over most of the band. In my own case, I was only interested in operating up to about 3.8, but the antenna performs very well right up to 4.0 MHz.

The vertical structure is really very simple to build, as the wires are actually nothing more than insulated guy wires for the A frame. The construction of the frame will be covered in a moment, but first let's finish the antenna. The only way to really get the most out of the array is to have as good a ground radial system as possible. There is probably only one rule-of-thumb on radials: the more, the better. Being very cost-conscious, I found the cheapest source of copper wire for the radials was the nearest motor-repair shop. There is undoubtedly such a shop somewhere near every small town in the country, and of course in a city there will be quite a few. You'll find that in most cases you can get old motor coils either free or for a nominal chargeusually based on the junk value of copper per pound. Another excellent source of such wire is an old line transformer or distribution transformer which your local utility may have removed from service. In a farming area, electric fence wire is fine.

The method of laying the wire must be

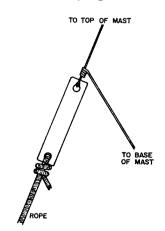


Fig. 2. Details of the insulators in the antenna.

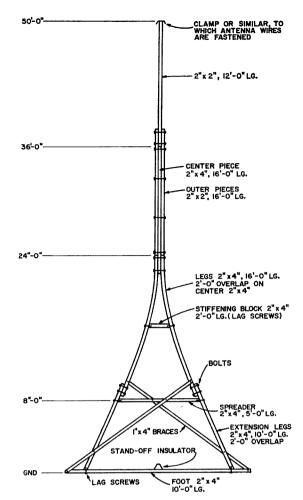


Fig. 3. Construction of the 50 ft. wooden mast for the vertical. Don't use a metal mast.

determined by your own geography. In grassland or sod, it's easy to cut a slit in the sod and tamp the wire down out of sight. In rocky terrain, it may be necessary to either dig out a path or merely lay the wire on the ground and cover it with some loose dirt or sand. The wires need not be in a straight line; almost any configuration will work.

You will find that laying the radials is the biggest and hardest part of the array, but doing a good job here will really pay off on the air.

In the case of my own antenna, I used RG-8 coax, 52 ohm, which matched the thing very well without the use of any other devices. The SWR over the band was about 1.3 to 1.8, which is certainly good enough. Undoubtedly the match could be made more perfect at some frequencies, or a tuning unit could be used to adjust the antenna as one moved across the band. However, the best feature of the antenna as it stands is one's ability to move around the band at will, and without any extra tuning en-

cumbrance.

Making note of the fact that the antenna is also a half-wave high at 40 meters, I have plans to include a tuning unit mounted right at the base of the mast and remotely controlled from the shack. However, this has not yet evolved past the paper stage.

In actual use on the air, the antenna performs as well as the inverted V on short haul contacts, and does very well on DX. Best DX (considering their rarity) has been ZD7 and VS9, but very good reports have been received from Europe, South America, parts of Africa, etc. It is especially nice in a contest to be able to dash hither and yon over the band without constantly grabbing for the plate tank controls!

Fig. 3 shows the construction of the A frame, which is very straight-forward. This is actually an A frame which I have used not only for this antenna, but also to support at times a 40 meter ground plane, inverted v's, one end of dipoles, etc. so its use as a general purpose support is very extensive.

The main points to consider are the ultimate height, and the weight which will be supported. In this area of high winds, ice, sleet, etc. I used the best quality 2 x 4 lumber I could find, and used a liberal coating of wood primer and two coats of exterior house paint. Since the longest lumber I could find was 16 feet, I used extension pieces on the bottom. At the top, I used two lengths of 2 x 2 to both steady

the upper piece of 2 x 4 and also to act as a bracket into which the top section of 2 x 2 was inserted. Since the radiators are acting as guys fastened right at the top, the 2 x 2 is plenty strong enough. Depending upon your local weather conditions, you may or may not require the use of a second set of guys about half way up the tower.

When the A frame is laid out for raising, the wide base will make it an easy task for three people. In fact, if you can secure your guys at right angles and have the use of a small block and tackle, with a tree or similar anchor, you can raise the mast all by yourself.

Because of slight flexing and "working" that takes place in a high wind, I would suggest using only bolts in the mast; nails have a habit of working out at the most unlikely and least desirable times. The guy ropes need not be expensive; I use synthetic cord used to make deep-sea fishing nets, and it works very well.

As a last comment, I hung a 40 meter inverted V right at the top of the mast, and found that this upset the SWR considerably on the vertical, pushing it up to about 2.5 all over the band. This can be taken out by a little tuning at the base, but is probably best avoided by simply not hanging anything else on top. After all you have gone to the trouble of making a pretty good antenna so why spoil it?

. . . VE1TG

Temporary Knobs and Tuning Tools

When working with gear have you ever come across a control you couldn't adjust? It may be inaccessible (as inside an *if* can), or odd shaped, or both. Tools fitting some of these shafts aren't even in the catalogue let alone on your workbench. Fortunately there is a quick, cheap, easy solution to the problem—the ubiquitous ballpoint pen.

Here's the trick. Take the plastic outer barrel of the (presumably) empty ballpoint and remove any metal molded to it. This can be done with a match or a cigarette lighter used as a cutting torch. In the same way melt the barrel till the end is almost the same size as the shaft to be turned. Do this so the barrel will still fit into the space available. Now *slowly* heat the end until the plastic is just softened. Quickly

push over the shaft and let it cool. You will have no trouble removing the pen in a few seconds after it has hardened completely. If done carefully, this process can be repeated several times until a good fit is obtained.

You now have an insulated tool of surprising durability. I have used the same pen barrel to tune a T23/ARC5 for five years. Another one has turned the motheaten splined tuning shaft of a Q-5'er all around the passband of my receiver since Christmas. I suppose as it wears out I'll just reheat it until the cost of matches approaches that of a surplus knob, or vice versa.

You can squeeze even more out of this. A tapered barrel can be treated on each end to make a combination tool. Other applications are limited only by ballpoint sizes, and probably not even by that, using the amateur's last resort . . . ingenuity.

. . . Thomas Kuffel KOYPB

A Reliable Directional Coupler and VSWR Bridge for VHF-UHF Use

The average VSWR bridge isn't very satisfactory in the VHF or UHF range. This article describes an easily reproducible directional coupler that can be trusted even at 1300 MHz.

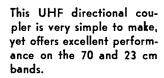
The aerospace industry has fostered the development of many new components and materials. Hams, being the kind of people they are, are quick to see practical applications for these materials that never occur to design engineers. I have often heard the criticism that it is impractical to publish articles or design ham gear with these new or expensive materials, because most OM's don't have access to them. Yet I've often been dismayed when I learn of an application for a piece of surplus equipment after it is no longer available. For this reason I feel that we should publish any application that is practical regardless of how immediately it can be used. Sooner or later, the material will show up on the surplus market and then we'll know what use can be made of it.

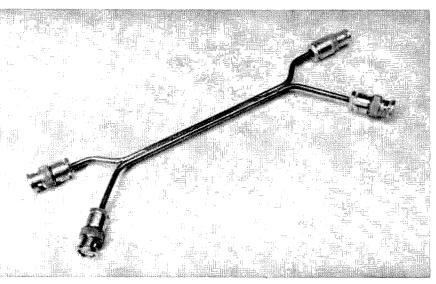
Reliable test equipment for the VHF-UHF bands is difficult to come by on a low budget. The literature is full of "relative" measuring devices but few pieces of homebrew gear are engineered for repeatable performance. Several directional couplers have been built according to the descrip-

tion in this article and each has measured to within ±.5 dB of the designed value. This is due in part to the mechanical rigidity and close tolerance of RG-141 "coaxitube." No special tools are required outside of a cheap pair of vernier calipers. The tools used to make the original coupler were an Xacto knife, file, soldering gun, vernier calipers and a vise. Don't let the calipers scare you. If you're not after a closely calibrated device they may be omitted.

The design goal was a directional coupler with about 30 dB directivity in the passband with a low insertion loss. Each milliwatt measured at the coupling arm equals one watt through the main line. Such a device is the heart of a good quality VSWR Bridge. The measured values were 30.3 dB coupling and 38 dB directivity at 432 MHz. Data presented in the graph was taken using HP608C and 614A signal generators and a General Microwave R. F. Power Meter. The measured insertion loss was 0.2 dB.

Resolution of the smallest possible VSWR is limited by directivity. Few of the handbook VSWR bridges or the low cost type





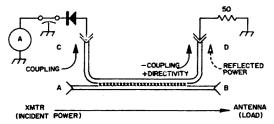


Fig. 1. A typical directional coupler. This device is the heart of a VSWR bridge, and can also be used for many other applications.

attractive to the CB trade achieve as much as 20 dB directivity. Thus the minimum discernable VSWR is approximately 1.7:1. With 38 dB directivity, 1.02:1 VSWR's can be accurately measured.

Directivity may be defined as the isolation of arm D from arm A, over and above the coupling as shown in the Fig. 1. Coupling is achieved by removing part of the jacket between adjacent coax conductors. If the input is at arm A, incident power can be sampled 30 dB down at arm C but appears -68 dB at arm D. Reflected power entering arm B is sampled -30 dB at arm D while at arm C it is -68 dB. It stands to reason if the directivity is low, one cannot tell with certainty if he is measuring incident or reflected power. Port D may be used as the dc return for a detector at port C and vice versa.

This device will have its fundamental passband where the length exposed between the two lines is $\lambda/4\sqrt{\epsilon_r}$. It will also have a passboard at (2n-1) $\lambda/4\sqrt{\epsilon_r}$ or at three, five, seven, etc., times the frequency for which it is a quarter wave. Hence a coupler designed at 432 MHz is usable at 1296 MHz.

This coupler has also been used to measure relative power and modulation at 2 meters where its coupling factor for incident

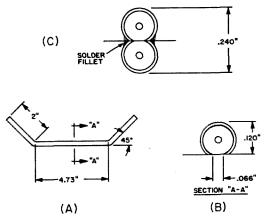


Fig. 2. Details of the construction of the UHF directional coupler.

power is approximately -40 dB but the directivity is poor, hence arm D must be terminated in 50 ohms. It's a real aid for tune up and will give a good indication of increased power with AM modulation right in the r.f. line. RG141 will handle 500 watts of rf up to 2000 MHz.

The formula for determining coupling length is

$$\frac{c}{4 \text{fo } \sqrt{\epsilon_r}} = \frac{\lambda c}{4 \sqrt{\epsilon_r}} \quad \text{or } \frac{300 \times 10^8 \text{ cm}}{4 \times \text{fo } \times \sqrt{2.1} \times 2.54} \quad \frac{\text{cm}}{\text{ln}}$$

$$= \frac{\lambda c \text{ inches}}{4 \sqrt{\epsilon_r}}$$

 $\sqrt{\epsilon_r}$ for Teflon = $\sqrt{2.1}$ = 1.449

From these calculations $\frac{\lambda_{\text{coupling}}}{4}$ at 432

MHz is 4.73 inches. With an Xacto knife cut two pieces of line 8.73 inches long and carefully bend them so that they form the shape shown in Fig. 2A.

Clamp the bent coax into the vise and file away the copper jacket taking care that the filed surface is smooth and flat. A belt or stationery disc sander works well too. A cross section of the filed piece should look like Fig. 2B. Next fit the two pieces together so that a cross section would look like a figure 8 and secure in a vise. Heat with a soldering gun only. Do not use a torch. Avoid excessive heating. Flow solder between the two lines as shown in Fig. 2C. The "arms" can now be bent into any convenient configuration provided enough allowance is made at the ends for connector assembly. A good rule to follow is a minimum bend radius of half an inch although a quarter inch radius is permissible. The arms should be approximately two inches

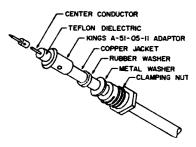
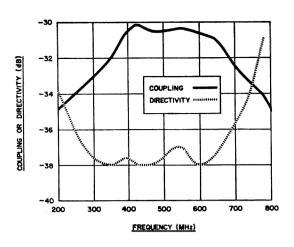


Fig. 3. Use of Kings A-51-05-11 adapter for using GR-141 with standard BNC connectors.



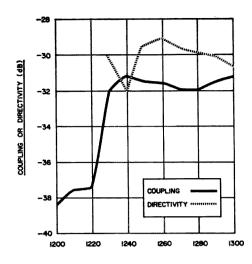


Fig. 4. Coupling and directivity for a directional coupler similar to the one discussed in the text. This device used a coupling wavelength of 4.635 inches rather than the 4.73 inches specified in the text. The only effect of the longer wavelength is to center the curves on 432MHz instead of about 500 MHz.

RG 141 has the same cross section as RG 58/U without the vinyl jacket therefore any connector that will accept RG 58/U can be used on RG 141 provided a sleeve is made up to make a snug fit in the clamping nut. A special adaptor is made by Kings for this purpose and sells for 45 cents. The connector assembly is shown in Fig. 3. Three RG 88E/U and one RG 89C/U connectors were used on the coupler shown in the photo.

Fig. 4 gives the measured directivity and coupling for this type of directional coupler at both 70 and 23 cm. You can see that performance is quite satisfactory.

Fig. 5 lists a number of applications for a directional coupler. The detectors in the measuring instruments should be suitable for use at 500 or 1300 MHz.

. . WA6SXC

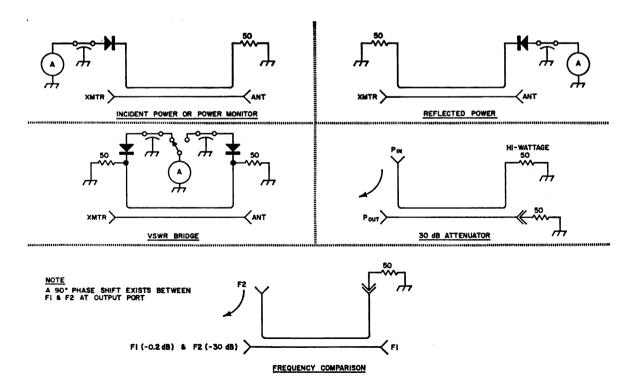


Fig. 5. Applications of the directional coupler described in the text. Unlike most pieces of ham-made test equipment, this one is good at 450 and even 1300 MHz.

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Common Base Mixer

73 Magazine

The transistor common-base configuration offers good frequency response, isolation between input and output, very high output impedance, and lots of gain.

Generally used only as an amplifier, it also makes a fine mixer. The parts required are one transistor, an output arrangement, and perhaps a resistor and capacitor. Fig. 1 shows the complete circuit.

L1 and L2 are low impedance links bringing the rf and local oscillator signals. They are in series as shown, not in parallel. No base biasing network is required.

L1, the oscillator input, is wound for about 1 mA of mixer current. R and C are there only so you can measure this current without breaking into the circuit. Then L2

tector. What . . . don't you know what a unity coupling is?

Fig. 2 shows a unity-coupled coil. The two equal windings are wound together. Since the mixer generates lots of noise, including a fine audio hiss, it cannot be coupled directly to some regenerative detectors. The unity coupled winding has present

Peterborough, N.H. 03458

is set up for good signal performance, start-

ing with about one-tenth as many turns as

tuned circuit of an if transformer, or a

unity-coupled input to a regenerative de-

Z is the output load. It may be the

there are in the rf or antenna coil.

tectors. The unity coupled winding has practically the same rf characteristics as a direct coupling, but doesn't transfer the audio and dc. Simple!

. . . Jim Ashe W2DXH

WINDING NO. 2

Fig. 2. A unity coupled coil as used for Z in Fig. 1.

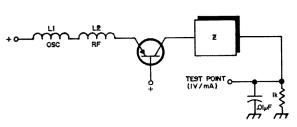


Fig. I. A PNP common base transistor mixer.

FEBRUARY 1967

A Solid State Antenna Relay

Mechanical relays and conventional TR switches are unsatisfactory for the ham who wants to enjoy the ultimate in operating. This silicon diode switch offers excellent performance and overcomes the faults of other methods of switching.

A TR switch is basically a single pole single throw switch in series with the receiver, which is controlled by transmitted rf. An antenna relay is a single pole double throw switch controlled by a dc signal. A TR switch has several disadvantages, notably suckout and TVI. A mechanical antenna relay is slow and noisy. A solid state antenna relay has all the good features of both.

The device described here is a diode double throw switch with a dc control lead. It causes no suckout or TVI and does not require tuning. It is fast and silent in operation. It introduces negligible loss on receive.

Theory

The basic switch element in this relay is an

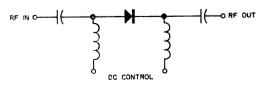


Fig. 1. Basic diode switch element. The diode is silicon. The dc control bias is switched in polarity to open or close the switch.

ordinary silicon rectifier. Fig. 1 shows how de bias and an rf signal may be combined on a diode. If the dc bias is in the reverse direction, the series rf impedance is high (open switch), and if the dc bias is in the forward direction, the rf impedance is low (closed switch). Both of these conditions hold only if certain constraints are met. In the reverse case, the peak rf voltage must not exceed the dc bias or rectification will occur (hence TVI). In the forward case, the rf current must not exceed a value relative to the dc bias which would remove all stored charge in the diode in less than 1/2 cycle; with typical rectifiers this means rf peak = 10 times dc average at 3.5 MHz. Thus a circuit like Fig. 1 is an rf switch which can be controlled by a dc bias.

Fig. 2 shows how four such switches can

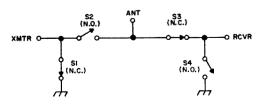


Fig. 2. Four simple diode switches can be combined into an antenna relay.

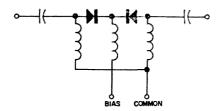


Fig. 3. A simple variation of Fig. 1 avoids charging up a large capacitance when changing from closed to open.

be combined into an antenna relay.

The type of diode used and required bias voltage depend on the open rf voltage and closed rf current in the switch. SI and S3 are subject to high voltages and low currents. 2000 volt 1 watt rectifiers are used with 900 volts of reverse bias and 5 mA of forward bias. S2 must handle high current so five 1 watt diodes in parallel are used, with 1 amp forward bias and 60 volts reverse bias. S4 operates at a low level; a ¼ watt diode is used with 5 mA/60 volts bias.

Fig. 3 shows a variant of Fig. 1 where the bias circuit does not have to charge up a big capacitance when changing from closed to open; this is used for S1, S3 and S4. The leakage from the transmitter during reverse periods may be reduced by use of a toroidal neutralizing transformer.

Band		Leakage from Tx on Revg*	
80	-67 db	-17 dB	2.0 dB
40	-63	-15	0.2
20	-46	-50	2.0
15	-47	-33	
10	-47	19	1.0

Suck out is less than 0.1 dB on all bands. *Balanced at 14 MHz.

Switching times:

Receive to transmit 0.3 ms

Transmit to receive 0.7 ms

Power capability greater than 1 KW at 80 and 15 meters (tested). Rated 2 KW 3-30 MHz.

Impedance: 50-70 ohm unbalanced

Table I. Performance of the antenna relay.

Operation

Fig. 4 shows the complete rf unit of the relay. As can be seen, it has two dc control inputs A and B. A requires -60 volts at 30 mA on RCV. and +1000 volts on XMIT. B requires -60 volts on RCV. and +5 volt/1 amp on XMIT. Fig. 5 gives a control circuit which supplies these signals.

The operation of this circuit is as follows. On recieve, the control input is grounded, cutting off Q1, whose collector rises toward +20 volts. This cuts off Q2, which goes to

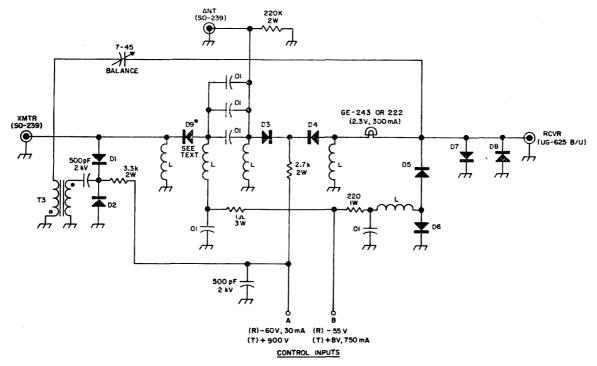


Fig. 4. Rf switch sub-unit. D1 through D4 are 2000 PIV silicon recifiers. D1 and D2 are matched with L in series with D1. D3 and D4 are matched for V_P at 10 mA forward current. D5, D6 are 200 V, 1/4 W rectifiers. D7 and D8 are 1N191, 1N3666 or 1N34A. D9 is five diodes in parallel. See text. Each L is 12.5 feet of number 37 enamelled wire on a 3/8" diameter fiber tube, 3/4" long winding. (60 μ H, 4Ω dc resistance.) T3 is 10 turns of number 25 Formvar bifilar wound on 3/16 ID, 3/8 OD thick Q2 ferramic core.

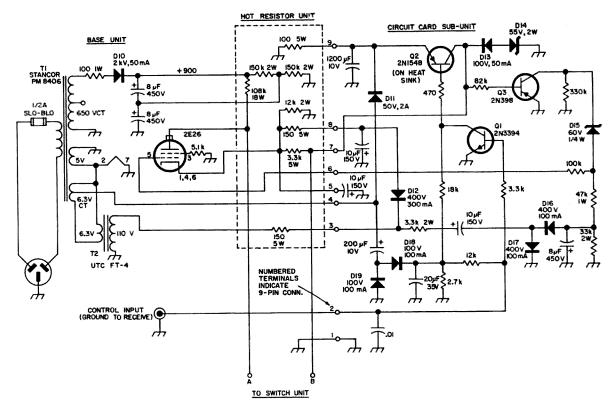


Fig. 5. Power and control for the antenna switch. D10 is a 2000 V, 50 mA rectifier (1N2328). D11 is 50 V, 2 A. D12 is 400 V, 300 mA. D13 55 V, 2 W zener. D15 is 60 V, 1/4 W zener. D16, D17 are 400 V, 100 mA. D18, D19 are 100 V, 100 mA. Q1 is NPN silicon, $H_{\rm FE}$ over 20 and $V_{\rm CEO}$ over 25. Q2 is PNP, $H_{\rm FE}$ over 75 at 1 ampere and $V_{\rm CEO}$ over 75 V in TO-3 case. Q3 is PNP, $V_{\rm CEO}$ over 100 V.

-54 volts clamped by the zener diode. This supplies the B signal. It also saturates Q3, whose collector forward biases, the 2E26, so that A is -60 volts as required.

On transmit, the control input is ungrounded, so Q1 is saturated, as in Q2. Q3 and V1 are cutoff, thus supplying the required A and B signals.

Construction

Construction is not critical, except the rf section should be a subassembly laid out similarly to the schematic and wired with short leads. No heat sinking is required on any of the diodes. The power dissipating resistors should be mounted in the clear atop the chassis. In the prototype, a plugable card held the transistorized drive circuit. The prototype was built on a 5 x 7 x 2 inch chassis and is 6 inches high.

Special components

The diodes used for D9 in the switch unit must be carefully chosen. The authors used 400 PIV 1 amp units similar to IN1763. Each unit could handle 1 amp rf with 100 mA dc bias. (50 watts at 50Ω) Since P =

I2R, 5 diodes in parallel can handle 1 kW. The requirement on the diode is that the stored charge be sufficient to avoid turn-off in a half cycle at 3.5 MHz. This means high efficiency diodes should not be used. Probably most "top-hat" silicon rectifiers will do. To test a given type, place 1 diode at the D9 position and temporarily replace R1 100- Ω 2-W resistor. (This will give about 100 mA de bias.) Load a 3.5 MHz rig up to 75 watts input with a 50Ω dummy load. Connect the relay in the line and close your relay key for a few seconds. If diode gets hot, the type is no good. If not, close the key for 5 minutes; the diode should stay cool to be acceptable.

Operation

In operation, the relay is used like an ordinary mechanical relay. Care must be taken that the control signal is properly sequenced to avoid applying rf when in the receive position. Table 1 shows the loss, isolation and switching times. Needless to say, this unit lends itself to fast highpower break-in with one antenna.

... K2IYC

Video Camera Tubes

There are many ways to generate a video signal. This article discusses them, whether they be well-known or rare.

Many developments have been made in the field of television, the modern camera tube being one of them. The tube, as a unit, has come a long way from the first type which was used in the 1939 World's Fair. This early device was known as the Nipkow Disk, and its operation was quite simple (Fig. 1).

As the wheel rotates, the light, coming through each hole as it passes the object, goes through the wheel and then to the photocell. Since the photoelectric cell is sensitive to changes in light intensity, the varying intensity will cause a voltage to be produced that will vary directly with the light. This varying voltage then becomes the video signal. Each individual hole in the Nipkow Disk contains a lens to properly focus the light to the photocell. A further development of this system that worked along the same lines as the original, with some variations, was known as the Modified Disk (Fig. 2).

An arc light is placed behind the disk and the object is kept in complete darkness. The light coming from the arc lamp is made to pass through the holes in the disk and is then reflected off the object. The light variations are picked up by the sensitive electric eye. These light variations cause a voltage to be developed in the cell. This voltage represents the varying light intensity and is the video signal.

Fly spot scanner

The modern camera tube evolved from these primitive systems, the first type being called the "Fly Spot Scanner". The theory of operation of the Fly Spot Scanner is much the same as that of Nipkow Disk, except that the arc light and the disk are eliminated. This system is still used extensively in the transmission of television, especially in color television. It has also found much use in closeup and still work, as well as the transmission of the television test pattern.

Extensive research in the field of photoelectricity and vacuum tubes brought forth a new development in camera tubes. The

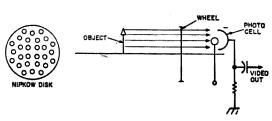


Fig. I. Nipkow disk video pick up.

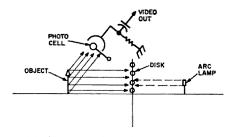


Fig. 2. Modified Nipkow disk.

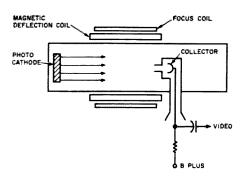


Fig. 3. Image dissector.

idea of the original Nipkow Disk and the photoelectric cell was incorporated into a device called the "Image Dissector" (Fig. 3). This was to be the first camera tube that could reproduce moving images. In order for the tube to properly operate, a photosensitive cathode had to be developed. This element emits electrons when placed under the influence of light. Inductors wound on an iron core, called focusing coils, are placed in certain positions around the outside of the tube. These focusing coils are used to keep the electrons, which are emitted from the cathode, traveling in a straight line or stream. Through the action of the focusing coils, the electrons are deflected in a horizontal direction as well as a vertical direction.

At one instant in time, all the electrons will hit the collector. However, in this process, a great deal of electrons are lost or wasted. In order to compensate for this waste of electrons, an electron multiplier is built into the vacuum tube (Fig. 4). The electron multiplier is a device in which each plate is at a higher potential than the previous one. When the electrons leave one of these plates to go to the next one, their velocity is increased due to the laws of electron ballistics. This action increases the force of the electrons as they strike the light-sensitive cell which results in a theoretical amplification of the original light. A greater potential is then developed at the output of the camera tube, which, in effect, results in a larger video signal to be produced and fed to the video amplifier.

As the state of the art improved, more advanced types of video camera tubes were developed. Among these were the Inconoscope, Orthicon, Image Orthicon, Vidicon, and Monoscope. In the following discussion, each of these video camera tubes is explained.

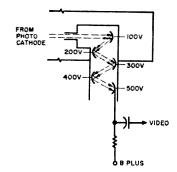


Fig. 4. Electron photomultiplier tube.

Iconoscope

The Iconoscope is shown in Fig. 5. On the mica sheet there are little globules of silicon. Each of these globules is insulated from the other by baking which results in oxidation of the silicon globules. The silver backing, which is coated with cesium, and the mica sheet make up the mosaic.

The scanning beam drives the point on the mosaic that is being struck to approximately 3 volts positive over the value of high voltage. This increase in potential is developed because of the loss of electrons from the mica sheet. These electrons form a cloud that exists close the face of the mosaic. While the beam is driving electrons into the cloud, there is a continual of electrons back on the entire mosaic. In the case of NO PICTURE on the mosaic, the amount of "raining" electrons is equal to the amount of secondary emitted electrons, and the net charge is zero. As a result of the zero net charge on the face of the mosaic, no current flows through output load resistor R1.

When a picture of differences is pro-

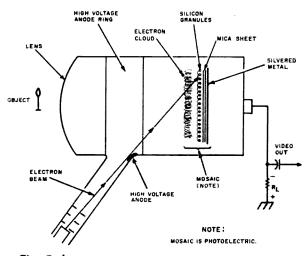


Fig. 5. Iconoscope.

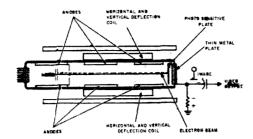


Fig. 6. Orthicon (low velocity beam).

jected on the mosaic, the bright areas under light charge up through the photoemission process and are positive with respect to the dark areas. When the electron beam strikes a bright spot, less secondary electrons are given up. Thus, the amount of "raining" electrons will exceed the amount of secondary electrons and will be equal in value on a dark spot. The greater the brightness, the greater the difference. The unbalance is reflected across the load resistor and is coupled through the capacitor as the changing video signal.

Orthicon

The Orthicon is shown in Fig. 6.

The anodes are metallic rings wrapped around the outside of the tube. The electron beam is emitted from the cathode. Each anode is set at a lower potential than the previous which results in a slowing down of the electron beam. At the time that the electron beam reaches the front metal plate, its velocity is practically zero. The metal plate is thin enough for the image to go through and activate the photosensitive surface to emit electrons.

The image light charges the photocathode positive on the inside. When the electron beam strikes the photocathode at a point, it will cancel the positive charge. The metal plate then discharges through RL, causing a negative voltage with respect to ground to be developed across RL.

The Image Orthicon is shown in Fig. 7.

ELECTRON

BUTTIFUES

OTRIGOT + 700 V 4130 VOLTS

ORTHICON

ORTHICON

TARGET SCREEN

DATE TARGET SCREEN

OF -2V ADJUSTABLE

OF -

Fig. 7. Image orthicon.

Image Section. This is the wide end of the tube and is comprised of a piece of glass with a coating of photosensitive material (photocathode). The optical image is formed on the photocathode on the light side while electrons are released from the side facing the target glass. A silver ring, which is kept at a negative potential of -500to -300 volts dc, surrounds the photocathode. The target glass is placed near the orthicon together with a very fine mesh wire (approximately 75 percent transparent) called a "Target Screen" with an adjustable potential of 0 to -2 volts de applied. The target glass is a very fine glass with very low resistance. When light strikes the photocathode, electrons are emitted, the amount of emission being directly proportional to the illumination of the photocathode. The electrons (E-) achieve an extremely high velocity as they are attracted toward the target screen. The voltage on the target glass is at the same potential as that on the photocathode.

Scanning Section. The scanning section consists of both the orthicon and electron multiplier. The electron multiplier produces an electron beam that is deaccelerated as it travels through the orthicon section. The electron beam is focused at the target by the magnetic field of the external focus coil. An alignment coil is also provided to develop a magnetic field that can be varied to adjust the scanning beam's position to correct for electron gun misalignment. Electron beam deflection to scan the entire plate is accomplished by the magnetic field of the vertical and horizontal deflection coils that are externally mounted. When the electron beam arrives at the target glass, its velocity is zero and, depending upon the potential of individual areas in the target, some of the electron beams land on the target while others stop at the glass surface and return to the electron gun. At white, the return charge potential is zero; at black, the return charge potential is

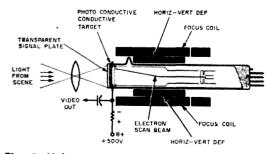


Fig. 8. Vidicon.

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maximum. Shades of gray are potentials between zero and maximum. These charge potentials are returned through the electron multiplier for amplification and become the video signal current.

Vidicon

The vidicon camera tube (Fig. 8) operates on the principle of photoconductivity, whereas all the other camera tubes function under the principle of photoemission. The beam hits the target with a low velocity, but not zero as in the Orthicon. Resolution is poor, and frequency response is good up to 4 MHz only. The vidicon has no shading requirement and has no burning effect. Its sensitivity is as good as the image orthicon.

The target is a thin plate, coated on the beam side by a photoconductive material. This material has a very high specific resistivity in darkness. When the beam strikes the dark portions of the target, a small charge is developed because of the high resistance. When the beam strikes the light portion of the target, the charge developed is greater because of the lower resistance of the light portions of the target. The video, a voltage function of the differences

in charge potential, is developed across the load resistor and the variations are coupled through the capacitor. With a signal current of 0.1 μ A for highlights in the scene across a 50-k Ω load resistor, the camera signal output voltage is 5 mV.

Monoscope

The monoscope (Fig. 9) is a camera tube with a fixed image and is used for camera signal test purposes. The operation of the monoscope is similar to that of the iconoscope. However, instead of the mosaic, a test pattern is printed directly on the etched plate.

. . . WB2GYS

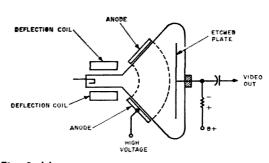
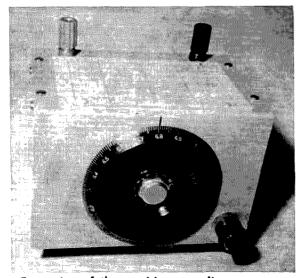


Fig. 9. Monoscope.

A Semi-Precision Capacitor

The precision variable capacitor is a very useful piece of test equipment which most hams don't have in their shacks. A capacitor of this type may be used in conjunction with signal generators and detection circuits for making many useful measurements; in fact, some measurements are very difficult, if not impossible, without a precision variable capacitor. Commercial precision capacitors are completely out of the reach of the average ham, but a neat substitute that will satisfy most amateur work may be found in the variable tuning capacitor from an old ARC-5 transmitter. These varable capacitors are extremely well made, stable, and incorporate an excellent antibacklash drive mechanism. Even at the currently high ARC-5 prices, the tuning capacitor would be difficult to duplicate.

The variable capacitors from any of the high frequency ARC-5 transmitters may be used as a semi-precision capacitor. Fortunately all of the tuning capacitors in this series of transmitters use the same range of capacitance, 34 to 154 pF. The manufacturing processes were very well controlled when these capacitors were originally made, so there is a direct correlation between capacitors from many different ARC-5 transmitters. I had an opportunity to



Front view of the precision capacitor.

check out several of these capacitors on precision laboratory equipment, and in each case the capacity at each point on the dial was within 0.5 pF of the other units; that's what I call pretty good correlation!

Most amateurs have an old ARC-5 transmitter laying around the junk box, so getting the necessary capacitor should be no problem; it doesn't make any difference what the frequency range of the transmitter is, they all have the same tuning capacitor. After you get the ARC-5, there are two ways you may proceed; you can cut down the ARC-5 chassis or you can build up a chassis similar to the one shown in the photographs. The cutup ARC-5 chassis isn't too pretty, but it's a little easier to make. The dial calibration of the completed unit won't differ between the two types of construction, so you can take your pick.

If you elect to chop down the ARC-5 chassis, remove the roller coil assembly and saw through the chassis 3% inches back from the front panel. Bend the bottom plate up at ninety degrees and trim it off so it is flush with the top deck of the chassis. Cut off the top half of the front panel just above the point where the dial index is attached. Now install two terminals; an insulated unit for the stator connection and a grounded one for the rotor. These terminals should be installed % inch in from the back edge and % inch in from each side.

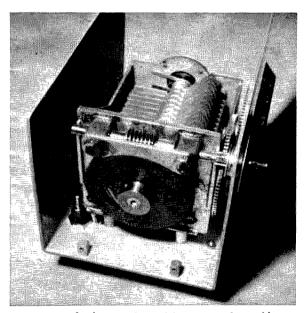
For the more complicated chassis shown in the photographs, refer to Fig 2. This chassis consists of two U-shaped channels made up from 1/16 inch aluminum sheet; one for mounting the capacitor, the other for a cover. Two pieces of hardwood clamped in a vise will help in making sharp 90° bends.

After the chassis is completed, you have to remove the tuning capacitor from the transmitter. This isn't too tough, but it takes a little perserverance and the right approach. After the bottom cover is removed, note that the tuning capacitor is connected to another variable capacitor in the rear of the unit through a flexible shaft. This shaft is pinned to the drive shaft of

the tuning capacitor. Turn the shaft so the end of the pin is facing you; then, using a small pin punch, carefully drive the pin out. if you don't have a punch small enough, an awl will do. Unscrew the large nut which holds the dial in place and carefully remove the dial. Be careful not to lose the small pin which locates the dial in the proper place. Usually this will stay imbedded in the drive collar, but sometimes it falls out. Now remove the dial lock knob. This is also pinned to a shaft and although sometimes it may be removed intact, usually it is frozen to the shaft and it's necessary to break it off with a pair of pliers. Remove the four screws which hold the capacitor to the transmitter and remove the rotor and stator connecting wires. The capacitor may now be removed from the ARC-5.

Before you discard the ARC-5 chassis, remove the large rectangular can on the rear of the chassis and note the four square studs that hold it to the main chassis. These studs will be used to hold your new chassis together. They may be removed by taking out the screws from underneath. These are the only four studs that will work; the other studs are riveted in place.

Installation of the capacitor in the new chassis should pose no problems if the holes have been drilled in the right place. Usually this is a little tricky however, since bending always seems to have a tendency to move the holes the wrong way. A little reamer will save a lot of cuss words here. Note that



Interior of the semi-precision capacitor. Note the two small square studs in the foreground which are used to hold the two U-shaped chassis together.

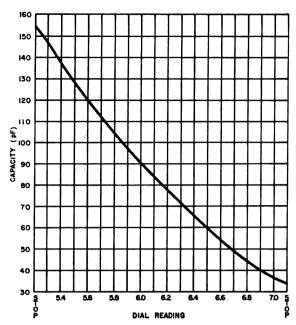
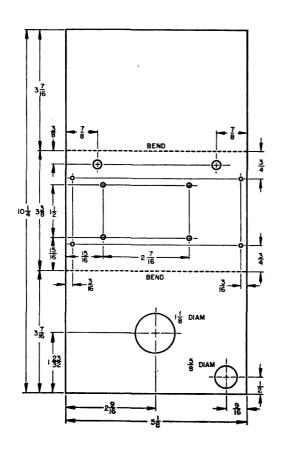


Fig. 1. Calibration curve for the semi-precision capacitor from a 5.3 to 7 MHz ARC-5 transmitter. Corresponding dial points for capacitors from 4 to 5.3 MHz and 7 to 9 MHz ARC-5 transmitters may be found in Table 1.

the chassis shown in Fig. 2 is based on the use of 1/16inch stock; the holes will end up in the wrong places if you use any other thickness. After the capacitor is in place, install a couple of insulated terminals in the holes provided, connect up the rotor and stator wires, and the semi-precision capacitor is complete. On my unit I cut out a one inch disc of aluminum and epoxied it to the knob for a skirt. It doesn't add anything functionally, but it does dress it up a bit.

1	Capacitance		
5.3-7.0 MHz	4.0-5.3 MHz	7.0-9.0 MHz	`(p F)
Stop			154.0
5.3	3.99	7.01	148.0
5.4	4.07	7.13	13 8.5
5.5	4.15	7.25	129.0
5.6	4.22	7.38	120.0
5.7	4.30	7.50	112.0
5.8	4.38	7.62	104.25
5.9	4.46	7.75	97.0
6.0	4.53	7.87	90.25
6.1	4.61	7.99	83.7 5
6.2	4.68	8.11	77.5
6.3	4.76	8.2 3	72.5
6.4	4.84	8. 35	66.25
6.5	4.91	8.46	60.75
6.6	4.99	8.59	55.75
6.7	5.07	8.70	50.75
6.8	5.15	8.82	46.0
6.9	5.22	8.94	41.5
7.0	5.30	9.06	37.0
Stop			34.0

Table 1. Individual calibration points for the semi-precision capacitor. This table is based on the major dial points of a tuning capacitor from a 5.3 to 7 MHz ARC-5 transmitter. Corresponding dial calibration points for 4 to 5,3 MHz and 7 to 9 MHz units are also listed.



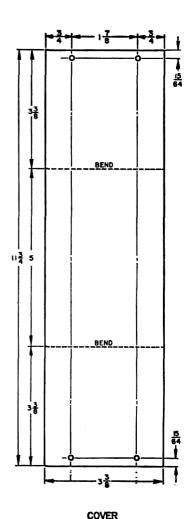


Fig. 2. Chassis for mounting the semi-precision ARC-5 capacitor. Each of these pieces is cut out from 1/16 inch aluminum and bent into a U. The dimensions will not work out properly if other than 1/16 inch material is used.

As a finishing touch you can put the calibration sheet on top of the capacitor and cover it with a sheet of thin plastic. Oh yes, four % inch rubber grommets on the bottom act as feet.

MAIN CHASSIS

If you use the calibration figures listed in the accompanying table, your semi-precision capacitor should be within about 0.5 pF any place on the dial. For more accurate calibration of course, you can borrow a lab capacitor and hand calibrate the unit exactly. When making measurements with the capacitor, the addition of six inch connecting leads will add 3 pF to the dial reading.

Now, you may ask, that I have a precision capacitor, what can I do with it? Well, there are many measurements that its use will simplify and some where its use is unique. I'll give you a few examples and let your ingenuity do the rest. The most obvious use of course is in the measurement of capacity. Connect the precision capacitor across an inductor and use a grid dipper to determine their resonant frequency. Now,

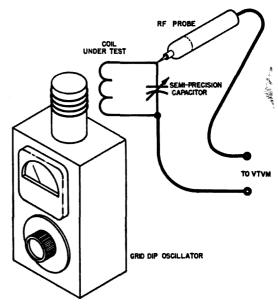


Fig. 3. Test setup for measuring the Q of a coil with the semi-precision capacitor. For highest accuracy, the VTVM should be set on its most sensitive scale and the GDO decoupled for full scale deflection.

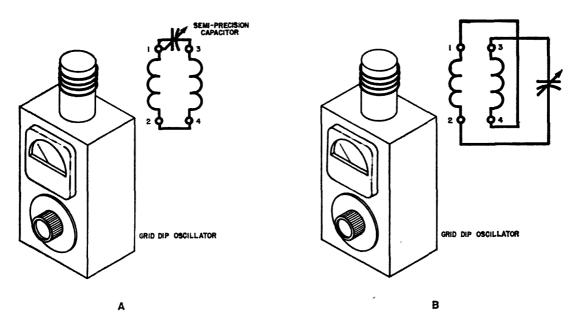


Fig. 4. Test setup for measuring the coefficient of coupling between two coils. Two measurements are required: one with the coils connected as shown in A, the other shown in B.

without disturbing the dipper, connect the unknown capacitor in parallel with the semi-precision capacitor, and tune the variable capacitor for another dip. The value of the unknown is the difference in readings on the precision unit. This method is very useful because it is very accurate, and with care quite small capacitors may be easily measured. Another method of measuring capacity is to place the precision capacitor in one leg of a bridge with the unknown in the other. A similar approach is used in many laboratory impedance bridges.

Where the precision capacitor really shines is in measurements that are difficult to make without it. The O of an inductor is one of these. In addition to the capacitor, you will need a VTVM and an rf probe plus a source of rf such as a GDO for this measurement. Connect the coil to the precision capacitor as shown in Fig. 3, set the capacitor at some convenient high value of capacitance (CR), set the VTVM on its lowest range and loosely couple the GDO to the circuit. Now tune the grid dipper for maximum deflection of the VTVM. If it pins the meter, move the GDO further away. Without disturbing the frequency of the dipper or its coupling to the coil, set the precision capacitor to a lower value than C_R so that the VTVM reads 70.7% of the voltage recorded at resonance. Record this new value of capacitance as CL and set the precision capacitor to a value greater than C_R so that the VTVM again reads 70.7% of the original reading. Record this value of capacitance as C_{II}. The Q of the coil may be calculated from the following formula:

$$Q = \frac{C_{\text{R}}}{C_{\text{H}} - C_{\text{L}}}$$

where all the capacitances are in pF.

The precision capacitor is also helpful in determining the inductance of a coil. For this measurement all you need is a grid dip oscillator. Simply connect the coil across the capacitor and adjust the capacitor for a dip on the GDO. If the dipper is set to 10 MHz, and the capacitor tuned for a dip, it simplifies the math in the following inductance formula:

$$L = \frac{25,400}{f^2C}$$

Where L = inductance in microhenries
f = frequency in MHz
C = capacity in pF

In some cases it may be desirable to measure the distributed capacitance of an inductor. This may be easily done with the precision capacitor. In cases where a small value of capacitance is used in measuring an inductor, the distributed capacitance of the coil can cause a large error in measurement. To reduce this error, measure the distributed capacitance of the coil (C_D) and add it to the test capacity (C_D in the above formula) before making the inductance calculation.

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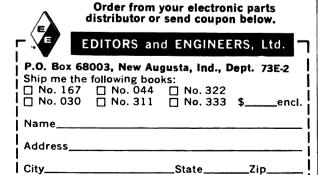
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To measure the distributed capacitance, set the precision capacitor to 50 pF and connect the coil across it. Couple a GDO to the circuit and tune for a dip; note the frequency and set the dipper to one half this frequency. Now restore the dip by increasing the value of the capacitance. Record this new value of capacitance (C_A) and calculate the distributed capacitance (C_D) from the following formula:

$$C_D = \frac{C_A - 200}{3}$$

Two other inductance tests where the precision capacitor is useful is in determining mutual inductance and coefficient of coupling. To measure mutual inductance, connect one of the two coupled coils to the precision capacitor and determine the resonant frequency with a grid dipper; calculate the inductance of the coil with the formula previously given. Do the same thing with the other coil. The value of mutual inductance (M) may then be found from:

$$M = \frac{L_1 - L_2}{4}$$

where L₁ is the larger of the two inductances.

To measure the coefficient of coupling between the two coils, determine the mutual inductance as shown above. Then connect the two coils to the precision capacitor as shown in Fig. 4A and calculate the total inductance using the resonant frequency method; record this value as L₁. Now connect the two coils as shown in Fig. 4B and again determine the inductance (designated L₂). The coefficient of coupling (k) may then be determined from:

$$k = \frac{M}{\sqrt{L_1 L_2}}$$

These examples show just a few of the things that the precision capacitor may be used for; most of them may be accomplished by other more exotic methods, but the use of the precision capacitor greatly simplifies things. Before I built the precision capacitor, I solved most of the problems involving inductance, mutual inductance and coefficient of coupling by the old cut and try method. The precision capacitor gives me immediate answers to these problems and saves a lot of time and frustration. In addition, it is a very versatile unit and every day I find new and unique uses for it in my shop.

... W1DTY

Down With the Rotator

Can't put up a tower? Why not use a TV telescoping mast with the rotator at the base?

Every ham can't have a tower. There are various reasons why a tower just isn't in the scheme of things. The three main reasons are—they cost too much, look too large, and take too much planning and work. For the VHF man, the solution is simple—each obstacle can be overcome.

Assume that a sixty foot crank-up tower would satisfy the requirement. The VHF beam could be at the sixty foot level, and when the tower is cranked down, it would be no higher than twenty five feet. For many of us, even twenty five feet is too high for comfortable work. Let's go one better.

What's wrong with a TV telescoping mast. Nothing at all. It will get your beam up close to sixty feet, hardly dent your pocketbook, won't look bad, and best of all, you can just about push it up and down alone. Further; when it's down, you can work on the beam at head level or at most, by resorting to a step ladder or picnic table.

The fifty foot telescoping mast can be procured at most of the radio supply stores. You can transport it home with the family car and carry it around by yourself. While the mast has washers for guying at every ten feet level, the writer has found guying at three points adequate. However, supports at four points would give greater comfort to your nervous system during storms.

It may be possible to push up the mast with a two meter beam, a six meter beam, and a CD type rotator at the top, but, when I tried it, it seemed to be too much like balancing a piece of wet spaghetti on end. As a result of a mental picture of the consequences, it was decided to put the rotator, the heaviest unit, at the base where it really belongs.

In the case of WA6SJH, it was decided to erect the mast adjacent the patio, whose roof was at the eight foot level. Accordingly, a heavy aluminum angle was formed and bolted to the patio roof siding. The horizontal face of the bracket was designed with a hole that permitted the bottom section of the mast to slide through it, but not bind.

A plumb line was then dropped through the hole center. At this spot on the ground, a four foot length of 2½ inch pipe was driven about two feet into the ground. As the pipe was driven, the top center of the pipe was periodically checked to assure its verticality. The top was then sawed off to present a smooth end. The rotator was then mounted on the pipe.

Next, by standing on the roof, the mast assembly was lowered through the hole and into the rotator and clamped. With no antennas installed, the mast was pushed up and checked for smooth rotation.

With the mast down, the guy wires were attached to the washers provided. Since only two sets of guy wires were desired, one washer was arranged to turn near the center of a section to provide better guying balance. The mast was again pushed up and the guys attached and adjusted. The guyed mast was then checked for smooth rotation. Friction from the guy rings was just right for smooth braking.

The mast was then lowered and a ten foot aluminum pipe was slid about two feet over the top of the push-up mast and bolted to prevent rotation. An eleven element two meter beam was mounted at the top and a pair of five element six meter beams below.

The assembly was then pushed up, carefully locking each section to prevent sectional slipping or rotation. One man can do the job, but two are better, since at maximum height there is push down against the guy wires and a slip at this stage would drop the top assembly ten feet.

This antenna system withstood the strong winds of the San Fernando Valley for over a year, until it was dismantled when the QTH was changed.

Rotation was always smooth and the rotator was at ground level where it could be easily serviced. . . . W3BTQ

Mobile Logs Personalized

Why not use personalized logs for your mobiling? They're simple to prepare, inexpensive and convenient.

Personalized mobile logs may at first appear to be an unnecessary luxury. However, when cost and convenience are considered, their value outweighs the slight extra initial cost involved.

Just as QSL cards may be designed especially for one person, or a stock design used at a lower cost, personal logs may be prepared in the same way. For those per-

MOBILE LOG OF WB6KFI FREQ _____ MC PWR INPUT ____ WATTS

FREQ	CALL TIME IN OUT		PWR INPUT	WA175	
CALL			LOCATION	REMARKS	

A personalized mobile log is very convenient.

sons who would like to completely design their own logs the information regarding FCC regulations and printing information will be of interest. For those who wish to follow the shortest route, the example may be used. The example may be removed from this magazine intact. Then, in place of my call, carefully transfer your call sign, in a type style and size that you prefer, from a sheet of the many dry transfer lettering sheets now available. Any art supply store and most radio parts suppliers now carry these sheets in a great variety of styles and sizes. The dry transfer process is parrecommended, although processes are available, because it is simple to use, errors can be rubbed off and started again, and yet it adheres well once applied.

Take the sample page, now complete with your call sign, to any print shop that provides offset printing service. Usually the smaller shops are better equipped and more receptive to small jobs such as this. A shop that works on QSL cards would be particularly suited for this work.

Your order to the print shop will be for: proper size offset printing, quantity as you desire, and either padded in fifties or loose, as you may wish to keep the log sheets in a loose leaf binder. If you can locate a printer who used the "Itek" process negatives the cost for production may be slightly lower than a printer who must use a film negative. The quality difference of the final printed piece is negligible between the two processes. Also, if absolute minimum cost is desired with possibly somewhat lesser quality, specify paper plates to your printer. However, keep it in mind that subsequent printings will require a

new plate, whereas a metal plate can be re-used many times.

The sample shown meets all FCC regulations for mobile operation, provided that the operator signs the log after each period of operation; or, if only one operator, he signs each page. For those wishing to design their own logs the printing cost will not change no matter how complex the design, as long as only one color is used. However, the log must show:

- 1. Date and time of each transmission. One entry for each day of operation is sufficient and can be placed across the "In-Out" column.
- Signature of each operator. This may be placed at the bottom of each sheet in the "Remarks" column together with 3, below.
- 3. Type and identity of vehicle.
- 4. Call sign of station called (whether worked or not, remember!)
- 5. Input power
- 6. Frequency band
- Type of emission. This can be placed once in Remarks column at the beginning of each sheet unless the mode changes before the sheet is completed.
- 8. Approximate geographical location of the mobile station. Normally one entry for each station worked is sufficient to comply with regulations as "US 80, ten miles W. Reno." This is the type of location identity that is legally required, rather than what is frequently heard such as "W6 . . . mobile W7." However, if you are covering a great deal of distance fast you are wiser to enter something like "US 80 between Reno and Fernley" for instance. The regulations say "approximate" and Webster says that is "nearly correct or exact", so there is some leeway allowed.

9. Messages handled. If traffic is handled, the information regarding their numbers may be placed in "Remarks".

The foregoing outlines what you must enter in the log to abide by the regulations. A review of Sections 12.136 and 12.137 should be made if you are in doubt about any portion of them.

A typical cost for printing 100 sheets is about \$3.00. Subsequent printings by the same printer will be less. Be sure you request return of the negative and plate he will produce. The plate is all that is necessary when requesting subsequent printings.

This log is very convenient to use on the car seat right beside you (provided you are not a southpawl). No rulings across the page are provided because it is too difficult to follow a straight line in the log at the same time as you follow one on the road. In fact, if necessary, it is quite easy to keep a respectable-looking log with barely a glance. For safety reasons, obviously, the best policy is to have the second operator keep the log.

By following the procedures given, you may also prepare your own personalized fixed station logs. In this case, rulings and additional information may be added to any extent you desire. Just remember to provide all information that the regulations require. As in the case of the mobile log, no matter how many items are added, your printing costs will remain the same for the same size sheet.

For those who would just like to purchase the log sheets without any of the preparation described, the author has arranged to have these made available, with your call imprinted, from WA6GMD at \$3.00 per hundred, including postage. Send requests to WB6KFI at address shown at beginning of article.

. . . WB6**K**FI

Attaching Shafts to ARC-5 Tuning Capacitors

The variable capacitors from ARC-5 receivers are very popular in amateur construction because they are well built and relatively inexpensive. There is one inherent problem though: how do you connect a conventional ¼ inch shaft to the splined shaft? The best method I have found uses a short piece of masking tape, some epoxy cement and a standard ¼ to ¼ inch shaft coupler. First of all, take a strip of masking tape

about ¼ inch wide and wrap it around the splined shaft to build it up to ¼ inch diameter. Put a little extra on and take it off turn by turn until it fits snugly into the shaft coupler. Now coat the tape and one end of the coupler with epoxy cement and put them together. In 24 hours you will have a firm coupling that may be attached to a standard quarter inch shaft.

. . . Jim Fisk W1DTY

Add a Crystal Filter to Your Receiver for less than \$10

Crystal filters are a luxury found only in the more expensive receivers. For some unknown reason, most literature available to the ham and the tinkerer sheds little light on how to make them. The advantage of having a crystal filter is unquestionable, especially with the crowded conditions of today's ham bands. The filter shown in this article is intended mainly for the CW man although it will be of some use in SSB. It has a continuously variable bandwidth from about 200 hertz each side of center, (or less) to somewhere around 3 kHz. A phasing control moves a sharp rejection notch through the passband virtually eliminating interferance almost on top of the signal you want.

Fig. 1 shows the passband of the filter. The steepness of the sides really depends on how carefully you build it. But even a poor job of construction can be a tremendous improvement over a low priced receiver with no filter.

Its operation is really quite simple to understand. Remember that a crystal looks, electrically, like a series tuned circuit with a very high Q. Also, the Q of the whole thing depends on how you load it. Finally, the Q determins the bandwidth, $(Q = {}^{t}/{}_{bw})$. Fig. 2 is a schematic of the filter. Part values will be given shortly. The crystal is ground to the *if* frequency. The *if* can feeding the filter has a heavy load resistor on

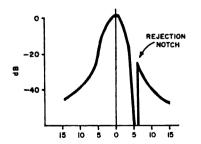


Fig. 1. Typical crystal filter curve at 3 kHz pass band.

it. (R1) This makes its passband very broad so the filter is the main controlling factor for that stage. When you don't want the sharp bandwidth the switch (S1) shorts out the crystal. A parallel tuned circuit (L1-C1) loads the crystal. The potentiometer (R2) varies the Q of the tuned circuit, thereby controlling the bandwidth. The variable capacitor (C2) balances out the capacitance of the crystal. The position of the notch is influenced by this control.

All parts for the filter should be positioned to keep lead length at a minimum. Otherwise you will have problems. (i.e. it will oscillate like a bird!) You would be wise to build the filter in a 2 x 2 x 3 Minibox and run shielded leads to the tie points. Controls can be brought out to the front panel by shaft extensions. Ground all your shields only at the filter end and then run a separate ground wire to the common point in the *if* section. If the receiver has two or more *if* stages, insert the filter at the input of the last stage. If the receiver has only one *if* stage, use a larger Minibox and build another.

You will have to doctor one of the cans so it can feed the filter. My suggestion is that you remove the can from the receiver and mount it on the filter box. This will also leave a convenient hole to bring leads in. Now, most if cans have their tuning capacitor built into the base. This has to go. If you break off the lug which connects to the internal capacitor. Then you can build up the base again with epoxy resin. If the can is tuned with a mica capacitor mounted where you can reach it simply cut it out and you're in business.

The two series capacitors, Cc replaces the tuning capacitor of the can. Unfortunately most manufacturers don't tell you what this capacitance is, so you're going to have to have to diddle. Trial and error is the best method. Connect the can back into the receiver with the capacitor removed, tune in

a strong station such as a local broadcast station, and try different values of fixed mica capacitors. The value which gives the strongest signal is your resonating capacity. If you have a National receiver with a 230 kHz *if* you will find 180 pF to be close enough. When you find this value, make each Cc twice that amount. (In the above instance, two 360 pF capacitors were used.)

O.K., so you build the thing and install it. Now you have to align it. If you have a signal generator you're lucky, but suppose you don't? Don't throw in the towel yet. A true ham knows how to make do. You need a steady CW signal (No modulation). You can use a VFO if you have one. However, if you're a poor man like me, use a cheap AM radio! Set the radio within handy reach and tune it to the top of the broadcast band. Take a single wire from the antenna lead of the receiver and let it dangle inside the case of the AM radio. You will find a nice strong CW signal somewhere around 2.055 MHz.

Peak up the can with the crystal shorted out. Then tune C1 for maximum output. Now set R2 for minimum resistance (widest bandwidth), unshort the crystal and peak up the whole thing all over again. I will warn you at this point that the tuning is awful sharp. When you throw in the crystal re-tune your signal source, or the receiver front end. Do it very carefully. With R2 at maximum, the signal will almost seem to ring. (I assume you are using the CW oscillator.) It will be very critical to tune and will sound very peculiar to one who is not used to crystal filters.

The filter has the narrowest passband when the load is heaviest. Just the opposite to what you might expect. The following

table gives parts values for 240 kHz and 455 kHz. The calculation of these values involves a lot of hairy math. If you are a whiz at math, or have had a couple of years of college, you will find the whole design process in the Radiotron Designer's Handbook. Otherwise forget about computing it yourself.

The filter is not too difficult to install. The input can of the filter is connected to the output of the preceding *if* stage. The filter is then capacitive coupled to the following stage. Notice that the bypass which was at the low end of the can before installing the filter is removed altogether. The resistor to the AGC line now goes directly to the grid, thus providing a dc return path. Bring a ground lead from the filter to a ground point in the *if* strip. Shield all leads connecting the filter into the circuit. Ground the shields only at the filter end. Mount the filter in such a position as to insure shortest leads.

The crystal is of the same type used for frequency control. When you order it, specify a series resonance at the *if* frequency. You can get one quite reasonably from Abbott Electronics, 85 Elm St., No. Woburn, Mass., if your local supplier can't get it.

If you buy a new if can, the supplier may be able to find out the value of the internal capacitor. This will save you some work, since Cc must be twice this value. Meissner makes a pretty good can as do quite a few others. The switch should be a SPST rotary type. You can get that in the five and ten. As for shafts and couplers, most suppliers have an ample stock to fit most needs. National has a wide variety of these.

.. WIUSM

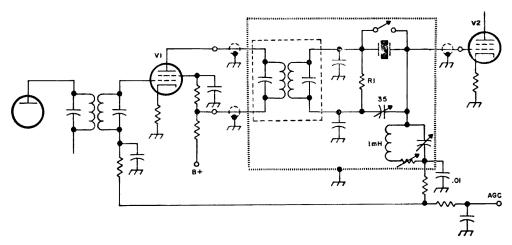


Fig. 2. If strip modified to include a crystal filter. R1 should be 3 k Ω for 240 kHz or 2.7 k Ω for 455 kHz. R2, 50Ω at 240 or 750Ω at 455.

A Reactivator for the Semiconductor Activator

A simple charger for automobile storage batteries.

Semiconductor circuits in general require a stable low-impedance source of power. While well-regulated low-impedance supplies can be built, and usually are included as an integral feature of the equipment, a separate power source is quite attractive for numerous reasons. Perhaps the most important is the feeling of confidence that if trouble develops, and it usually does, the trouble is confined to the circuit and not in the source of power.

Dry cells and the like are out as primary sources of power. They have fairly high impedance, intermittent connections if a pressure plate is used as with numerous flashlight cells, and can be quite noisy. The lead-acid storage battery is preferable in many respects. It can withstand heavy loads without budging due to its low internal resistance. It also has a very low ac impedance which is very suitable for powering amplifiers which may have regenerative (or degenerative) effects when used with less efficient power sources. But, the lead-acid battery does have a few disadvantages. It requires charging, is messy, and is rather expensive. Read on.

The first problem is getting the battery. Most gas stations have a few old trade-ins lying around. Casually pick out one that appears to be in fair condition and ask them to give it a short quick-charge to see

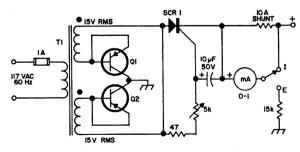


Fig. 1. Simple battery charger. Most of the components are not critical. They're discussed in the text. The dots by the transformer windings indicate the polarity of the rewound secondaries.

if will absorb the soup. On the way to the charger it wouldn't hurt to accidently drop the battery in a carefully planned trajectory on its bottom edge. This will serve to break loose the chemical build-up which frequently tends to short out cells. An old style battery with the lead straps exposed on the top is much better for obtaining tapped voltages. The second problem, the messy deal, is simple to overcome. Build a box out of old scrap lumber and hide the thing. Be sure the bottom is nailed inside the sides, rather than under them, so it won't fall out. Add a couple of pieces of wood for hand-holds. A top cover will help to keep the dust and dirt out, but be sure to leave ventillation holes for the gas to escape. We still have the third problem to overcome, so let's charge on.

The complete circuit is shown in Fig. 1. It uses a pair of obsolete germanium transistors as rectifiers, and an inexpensive SCR as a current regulator. Manual control with a potentiometer is provided for current conditioning. Metering to check the charging rate and the battery voltage is accomplished with the standard 1 mA indicator.

The transformer selected was originally rated at slightly over 60 watts. So—to avoid complications—a one ampere 3AG fuse was selected. There is some surge on turn-on, but the Slo-Blo fuses always seem to take out the transformer too, so a regular quick blow fuse was used. After you build a transformer personally you appreciate the need for protecting it properly.

The transformer used is not listed by name or number, although it was a very popular brand. The essential characteristics are a good power rating and ease of disassembly. This one had windings of 5 V at 2 A, 6.3 V at 3 A, and 350–0–350 V at 90 mA. It adds up to around 62 watts or so. It also adds up to a future life as a paper weight in this day and age. So, off with the secondarys. Cut off the high voltage one. When unwinding the 6.3 V and 5 V

sections count the number of turns. This is helpful in determining how many turns to put back on. Most standard transformers have the primary as the bottom or inner winding. Some special ones have the primary as the outer winding and should be avoided like work.

For up to ten or fifteen amperes, #18 wire is perfectly suitable. It only carries the current half the time, since a full wave rectifier is used. Use some fairly rugged paper for insulation between the layers. This helps to keep the winding smooth. On reassembly, it may be found that a few of the iron laminations won't fit in. Don't worry about it. If you used ordinary care in winding, stretched the wire to straighten it, etc., you now have a good quality suitable transformer. So put a load on it and connect it to the power line. It buzzes? Coat the laminations with lots of shellac.

Rectifier voltage drop is an important consideration at these potentials. If silicon rectifiers are used instead of the inexpensive germanium transistors, a few more turns must be added to the secondary windings. PNP germanium transistors are about the cheapest type low voltage rectifiers available today. They are mounted directly on the bare metal of the case, without mica washers or the like, to provide low thermal resistance. Delco 119-0016 were used but any suitable 10 or 15 amp types are ok. The SCR is also an oddball. Its ratings are required to be only 30 volts or thereabouts

breakdown and 10 to 15 amps conduction. It is most easily mounted directly to a flat piece of aluminum as a heat sink, and the heat sink then insulated from the enclosure. The power supplied to the SCR regulator is not actually dc, but rather a full-wave rectified ac. The simple resistor-capacitor network allows setting the gate turn on point as desired for the required current output.

Metering is done by an ordinary inexpensive 1 mA meter. A 10 amp (or 15 amp) shunt is easily constructed by making an air wound coil of #18 or #16 gauge wire. Measure it carefully, after consulting a wire table to find the resistance per unit length. For instance, with a 1 mA meter of 100 mV sensitivity, 9,999 mA must go through the shunt with the same voltage drop. It works out to about a dozen turns of #18, an inch diameter. Don't try to switch the current. This will create troubles. Switching the meter also allows checking the battery voltage. This information, while of doubtful value, does prevent errors such as reversed connections.

It will be found that the charging current is initially quite high, then tapers off to a steady value. No provision is made for an automatic cut-off so it is necessary to do that by hand. Unplug it. It should be unplugged anyway when using the battery for testing out circuits. Avoid AC ground loops.

. . . K6EAW

Antipodal Bearings

Several months ago, in reply to a comment about a QSO being long-path, VQ9TC remarked, "There are two long paths!" It may be a long way from W6 to VQ9, but it is a problem to determine where those paths are. An inspection of a great-circle chart will disclose that one longitude and one latitude occupy the entire border of the chart. This makes it clear why a station at your antipode may be heard from any direction that provides a good signal path, even though this path is neither "short" nor "long". When the antipode of a desired point falls close to your location, a small difference in the place on which the chart is centered, will make a very large change in the indicated bearing.

Even though you do not have a world

globe at hand, there is a quick way to determine the bearing of a place close to your antipode. First, pick off the latitude and the longitude of the distant place. Consider the South latitude as North latitude. Subtract the longitude from 180 degrees. distant point.

Let us take an example. The Callbook's World Atlas shows Kerguelen Island, FB8XX, at about 47S and 69E. Subtracting 69 from 180, we determine the antipode of Kerguelen to be about 47N and 121W. This falls approximately on Seattle, Washington. It is easy to appreciate, therefore, that the bearings from various points in the U.S.A. to Seattle differ drastically. A small change in the location of the distant point (such as by using Heard island instead of Kerguelen) also can make a surprising change in the bearings from your location.

. . . E. H. Conklin K6KA

The Ancient Marriner

An antenna tuner for co-ax-fed Tri-Band Beams

If you have tried all of the other tuners for matching your transmitter to a 52-ohm coax-fed beam with no results, try this one. Beam antennas generally are not very broad band. They resonate at one particular frequency and at that point the SWR might be 1:1. As tuning departs from that resonant point the SWR increases. There may also be other causes for high SWR, the amateur may have taped his coax to the leg of the metal tower and un-balanced the line. This article is not written to discuss means of getting rid of SWR but how to live with it. It is doubtful the efficiency across any amateur band will fall off to where it makes very much difference in signal strength. This article is concerned with, however, how to make sure the transmitter is looking into 50 ohms at all times. This will assure the antenna load will absorb the power out of the tubes so that they will not have to be replaced after you hold the key down.

Several years ago no one would give much thought to SWR on the feed line because the higher plate dissipation tubes were used in the output of the transceivers. As manufacturers started to use small TV sweep type tubes in the final, the operator had to be careful that he did not burn up the tubes.

Check your rig. Turn out the shack lights, load the rig up and press the key with

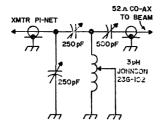


Fig. 1. A tuner for coaxial-fed antennas can help your transmitter see a 50-ohm load even though it has no effect on the SWR of the line running from the tuner to the beam.

the frequency tuned off from the resonant frequency of the beam. Observe a thin red line on the plate of the tube. Now connect a 50-ohm dummy load in place of the antenna, load up the rig and press the key. It is likely that the tubes will stay cool. This should prove to the operator that steps should be taken to do something about his antenna set-up before he has to replace the final tubes.

One solution to the problem would be to use some kind of a beam that could be tuned to the operating frequency. Generally this is not possible and the amateur is stuck with his coax fed beam. The solution now is to use a tuner so that the transmitter looks into 50 ohms regardless of the SWR on the antenna feed line.

The design of this tuner was just stumbled on by accident while fussing around with the 50-ohm Trans-Match described in the ARRL handbook. The split-stator capacitor was replaced with separate capacitors, and it was found that the SWR could be tuned down to zero. The values of the variable condensers should be at least 6250 pF for the 20-15-10 meter bands. It was also found that using a roller coil a better adjustment could be made for the null position. Once the minimum spot is found for one frequency in the band, only a slight adjustment is necessary with the roller coil to bring the SWR down at the new frequency.

Tuning proceedure

First tune the transceiver by using a 50-ohm dummy load. Next switch from the load to the beam antenna and use only a minimum of output, or just enough to see the SWR indicating. Adjust all of the variable condensers to a minimum of SWR, and also adjust the roller coil, which takes about three turns on ten meters and four turns on fifteen meters. The coil is one inch in diameter and uses #12 wire.

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oscillator only (NO MONITOR)	10.50

Model OM

AMECO EQUIPMENT CORP.

Div. of Aerotron, Inc. 178 HERRICKS RD., MINEOLA, L. I., N. Y. 11501

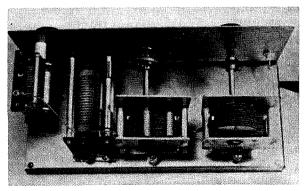
No tuner is used on 40 meters because the dipole cut to mid-band seems to do the job. The eighty meter band is 500 kHz broad and a dipole does not work across the whole band. Here it is better to use a center fed zepp and a match box tuner, unless the operator is only interested in the phone portion of the band.

Conclusion

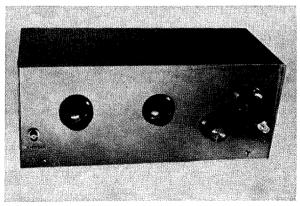
If you own a transceiver with small sweep tubes, and operate CW with a long duty cycle, just make sure the tubes are not getting hot from too high an SWR on the line. On the air fellows will tell you the pi-network will match the antenna, or they have never had any trouble. The pi-network, however, can't make a non-resonant antenna take out the power, and it will be dissipated in those cherry red plates. To save your tubes a coax tuner should be used.

Maybe someday in the future, beam construction will incorporate a way of resonating the driven element to the operating frequency. Let's hope so, then there will be no need to keep worrying.

W6BLZ



Inside of the coax antenna tuner built by W6BLZ.



W6BLZ's coax antenna tuner.

Climbing the Novice Ladder

Part III: Judy and Joe are really pitching!

After completing their code practice oscillator in FN's shop a few weeks back, Joe had stopped at Judy's place before going home. Her mother greeted him cordially and called Dad in from his cabinet shop on the rear of the lot; Judy's father was well known in the neighborhood as a master eraftsman in wood. Joe immediately felt at ease with this middle-aged couple; it was obviously a happy family which also included Judy's brother now away at school.

It being lunch time, Mrs. Mansfield insisted that Joe remain and share it with them; they could discuss their code practice arrangements during the meal. When Judy explained that she and Joe would like a quiet corner table somewhere that they could use several times a week for awhile, her Dad immediately offered a corner in his plywood storage shed which already had a long built-in, shelf-like table.

"Swell," Judy exclaimed, "it's still summer so we won't need any heat and there's a big window right over the table so we'll have plenty of light; I'll show it to you Ioe right after lunch".

Inspection of the code practice 'shack' confirmed Judy's opinion and as they had already arranged to get together every other afternoon until school started, Joe mounted his Honda and headed for home. The arrangement proved ideal. When Joe appeared in the early afternoons, not forgetting to pick up a few bottles of Coke, both youngsters industriously applied themselves to mastery of the code with occasional conversational rest periods and the always welcome 'snack'. It was not too many days before their efforts bore fruit; neither was giving more than an occasional glance at the printed code chart in the little book which FN had loaned to Joe. Their young minds quickly absorbed the dot and dash combinations which made up the various letter characters . . . figures and punctuation came a little harder. Diligent applica-

tion with the emphasis on these soon eliminated that stumbling block and it wasn't long before they were not only identifying the individual letters as sent by their partner, but short simple words as well. Toward the end of the second week Joe said, "Say, Judy", it's about time we went back to see FN and let him check our progress; he asked us to, you know. What say we peddle out there Saturday morning?"

"Fine with me Joe," Judy returned, "I'll meet you out there about 9 o'clock . . . OK?"

"Suits me," Joe replied, "see you then . . . s'long and . . . 73"!

"73 yourself OB and CUL" was Judy's very much ham-flavored reply. They had found these ham abbreviations in FN's little book and had memorized a few of them; 'OB' for Old Boy, 'YL' for young lady, 73 for best regards and 'CUL' meaning see you later . . . quite a string yet to go but they were picking them up as they went along.

Shortly after nine Saturday morning Joe had arrived at FN's shack and Judy was not far behind. They were welcomed with. "Well; you kids haven't been out for a couple of weeks now . . . how're you getting along with the code?"

"Well Gramps," replied Judy, "we think we're doing pretty good; Joe and I can talk to each other a little bit now with the key".

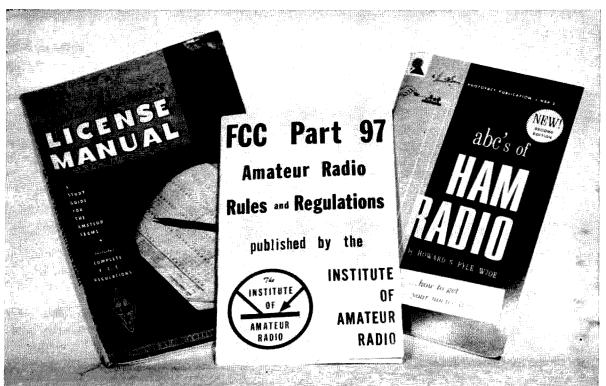
'Sounds good to me," said FN, "let's set up a practice set here on my bench and see just how good". So saying, he lifted his CPO from a shelf and plugged in the headphones from his shack. "You bring another pair of phones?" he questioned.

"Oh yeah", Joe replied, "they're in the carrier on my Honda . . . I'll get 'em". He returned in a few moments and plugged them into the dual clips on the CPO.

"First," said FN, "let's see what your sending sounds like; here Judy, send me the first line on this card", handing her an advertising circular. Slowly and carefully, Judy made it without error. "Now Joe, you send the same line" which Joe did but spoiled a letter 'S' by inadvertently adding a dot, making an 'H' of it. "All right," said FN after pointing this out, "let's sit down now and talk about sending before I see how well you can copy which is what we call it when we are receiving from the other guy". Joe pulled out FN's thinking couch and he and Judy settled themselves while FN wheeled his office chair from the shack and joined them.

"Judy, you've got the makings of a good 'fist' . . . that's how we refer to a fellow's sending style. Right now you're a wee bit hesitant . . . not quite sure of yourself. That's evident from your dots which are a bit too light. Make 'em more firm . . . like this" and FN reached over to the bench. handed them their headphones and made a string of dots on the key. "See what I mean? Don't forget though that the dot is just one third the length of a dash . . . not necessarily by 'micrometer' measurement but so that it will sound that way to a listener; try it now". Judy reached across Joe to the bench but FN stopped her with, "Uh uh . . . you can't send good with your arm in thin air Judy; get up and rest the big muscle of your forearm on the bench . . . push your key back about 18" from the edge. That's better, try it now . .. make a string of dots . . . no, no . . . don't quiver them out fast like that . . . take it slow but firm

... there, now you've got it. Now make several dot letters, 'I', 'H', 'S', and the figure '5'. That's much better now; keep it in mind. Aside from that you are doing all right although you both are a bit tense in your grip on the key; I'll give you a tip on that in a minute. Now Joe, you go ahead and send the same line on the card". Profiting by FN's advice to Judy, Joe through with better dot formation but showed a tendency to drag his dashes a bit now and then making them closer to four dots in length rather than three. Pointing this out to him FN said, "Uniform Joe . . . uniform . . . make all of your dashes the same length. Go ahead now and send me the letters 'O', 'M' and a few zeros several times" which Joe proceeded to do. "That's better, Joe, but practice it . . . your dashes still vary a bit . . . watch it and have Judy check you on it from time to time and you check her for light dots too. Now let me give you that little tip to break finger tension in holding the key. In the first place, don't grab it like it was going to run away from you nor simply tap it with one finger; just a firm, light grip does it. I'm not going to try to tell you how to hold the knob . . . just grip it in the way that's most comfortable for you. A lot of manuals will detail just what fingers to place where . . . skip it for now. As you



FN recommended that Judy and Joe get these three inexpensive booklets to help them learn the things they'd need to pass the novice exam.

progress there's a 99% chance that you'll slip into the "thumb, forefinger and middle finger" grip that is used by practically all experienced operators both amateur and professional. Don't try to rush it though . . . let it develop naturally. Every fist has a distinctive style of its own; most experienced operators can immediately identify what operator is holding the key even before he signs his call letters, just by his style of character formation, if he has heard or worked him a few times previously. It's a good deal like writer's style in that respect; they follow much the same pattern. I'm drifting away from the point though; holding your fingers stiffly straightened out will soon tire your sending hand and you'll eventually develop what we call glass arm, a form of telegrapher's paralysis which will make sending extremely difficult and your character formation very hard to read. Before you do any sending again, hold a little rubber ball, a plum, small orange or even a wad of paper . . . something about the size of a golf ball . . . in the palm of your hand and keep it there while sending. It will help keep your fingers rounded and prevent tension from developing . . . this way, see?", and taking a scrap of old newspaper from under the bench he crumpled it into a ball, cupped it in his palm and sent them a few characters on the key, then had each of them try it.

"Gee, F. N., it really helps, doesn't it Judy?" said Joe.

"Oh yes . . . it seems much more natural and it's easier to send" and she rattled off a few characters to prove it!

"OK then," said FN, "so much for sending; now let's see how well you copy. You put the headphones on . . . I won't need any while sending. Here's a scratch pad and pencil for each of you. I'll send you just straight English from this page in my book; see what you can do with it". FN sent for perhaps two minutes at a rate of about 5 words a minute. Long practice enabled him to judge speed pretty accurately. He stopped sending and they passed him their copy. After a few minutes thoughtful study, FN announced, "Well, that was pretty close to five words a minute which will be what you'll get in your examination. Neither of you copied it solid which is a term we use to mean every letter; you both made a few misses here and there particularly in the few figures and common punctuation I sent you. How come you missed all three periods Judy? Think a minute and you'll recognize the characters for a period as being simply three letter A's run together to make one character. Joe got all the periods but his weak letters seem to be 'Y, 'F' and 'L'; you didn't do so well on the 'L' either Judy; both of you seem to get 'F' and 'L' confused. When I sent you 'L' you both wrote 'F' every time! True, they are opposites in that 'F' is 'dit-dit-dah-dit' and 'L' is 'dit-dah-dit-dit' . . . 'F' turned around. Your job will be to untangle 'em . . . choose words with lots of these two letters when you practice. Also, try the simple words you learned when you were babies; dad, sis, mommy, baby, boy, girl, dog, cat, etc . . . that kind of stuff; lots of good practice material there.

"Well, you've shown me that you aren't quite equal to five words a minute yet which was hardly to be expected in this short time but your progress is excellent. Suppose we see now at just what speed you can make solid copy. I'll send for exactly two minutes by my stop watch and at a little slower speed using different words. Ready? go! Two minutes of silence except for the faint click of the key. Both kids turned in their papers and FN found one error on Joe's . . . the 'Y' again; he had written 'X'; Judy showed two errors but she got both periods correct this time. Her slips were between 'U' and 'V', only one dot different. FN then counted characters and said, "I was sending just a mite over 3½ words a minute . . . not quite 4. Judging from that I'm going to credit you both with solid copy at 3 words per minute; not a bad showing in two weeks. We'll drop the code angle now and discuss some of the other requirements for your license exam.

"First off, let me tell you a bit about the 'formalities'. You may think as a lot of budding hams seem to, that you will have to appear among a group of strange applicants and be examined by a Federal officer in totally unfamiliar surroundings. Any group examination as you know from your school tests, creates a mild form of nervous tension which has a tendecy to interfere with your thought track to some extent. In a radio code examination particularly, this is often responsible for failure to pass the first time and sometimes even the second even though the applicant has appeared qualified after having been checked by a friendly ham. The novice class however, gets a real break; they can be examined right in their own home or at any other place which both their examiner and theirself mutually agree upon. And, the examiner is not a Federal officer nor anyone else special; he (or she) can be anyone 21 years old or more who holds a valid amateur General class license or higher . . . even a member of your own family if he meets these requirements! I can act as your examiner, so can Larry . . . any ham with a General class ticket or better . . . you can choose your own examiner. You'll find all of the information in this little pamphlet and you can get a copy free by simply sending a postcard to 73 Magazine, Peterborough, N. H. 03458 and asking for "FCC Part 97, Amateur Radio Rules and Regulations". I suggest that you both do this; I'll loan you this copy until yours comes".

"What I'd like to do is this;" FN continued. "I would prefer that Larry, if he is willing, or one of the other qualified club members conduct the examination for Judy and I'll examine you Joe; that way neither of you will have a family examiner which will help condition you for your General exam which must be taken before a total stranger . . . the FCC engineer who will then examine you. If that's OK with you kids, suppose you ask Larry, Joe, if he will take Judy on when she is ready; I'm sure he will . . . you know him don't you Judy?"

"Oh yes, Gramps, he was a senior when I entered high school and I knew him slightly then and I've talked with him a couple of times since at the ham club . . . he's fine with me for an examiner".

"Good" FN replied, "you see what Larry thinks then, eh, Joe?"

"Oh sure . . . he'll do it though I know" said Joe.

"All right then, so much for the examination; it will be a few more weeks before either of you will be ready but we might as well start laying the cards. Now let's talk about another phase; what many hams refer to as the technical part of the examination. It really isn't technical in the true sense of the word . . . you Joe, with a couple of years of high school physics behind you and your own electrical experiments at home, won't have a bit of trouble there I'm sure. Judy may be a bit puzzled when a few terms such as watts input, final amplifier and such come her way . . . you can coach her here, Joe, as you run across unfamiliar terms in your study. For study material I'm going to suggest that one of you pick up the little book, Radio Amateurs License Manual, put out by the ARRL . . . that's the American Radio Relay League, a club to which about a third of the American hams belong. You'd better get that one, Joe, and Judy, you get a copy of the ABC's of Ham Radio published by the Howard W. Sams Co. With these two books which you can exchange between you, you'll find much more than you'll need to know for the exam and the little pamphlet on regulations you are sending for will take you over that hump. Your exams will be of the multiple answer type where you just make a mark opposite to what you think to be the correct answer among a number which you'll be given with each question. You won't have to draw a single schematic or wiring diagram; just check off your answers.

"Pay particular attention to the laws and regulations applying to radio amateurs; all three publications will give you these. You see, the FCC must be assured by your knowledge of these that you will be capable of legally operating an amateur radio station if a license is granted you. Knowing the rules is largely a matter of memorizing but you're going to have to read them a number of times so that you can intelligently answer questions on them. You don't necessarily have to memorize them word for word but get the meaning of each clear in your mind so that when you get a question reading like this; 'What is the penalty for transmitting a false distress signal? you will immediately know which of the several possible answers given you on the sheet you should check as the correct one. You'll find plenty of sample questions and answers in both the License Manual and the ABC's book as well as a wealth of additional material which will clear up many points of ham operation for you . . . pick up these books as soon as you can . . Jim Turner's Electronics Supply Co., here in town, has them both.

"Now you kids run along, pick up your books and keep on with your code practice. I'd like to see you back here in a couple of weeks and if you apply yourselves well you should both be doing your five word a minute or better in that time. Next time, after checking you out on code, we'll talk a bit about the equipment you're going to need to put a station on the air when you get your licenses. For now then, CUL and 73".

Off they went, tossing back like real dyed-in-the-wool hams, "73" to you too ol' timer ... BCNU!"

. . . W7OE

Terry Banks K3LNZ 426 Orange St., SE Washington, D.C.

Portable Operation Without Tears

The author was bitten by the Portable Operation Bug early in his ham careerin fact a mere six weeks after first being licensed. The first mild infection was contracted from a publication called "QST", which urged us all to take to the hills during an event called Field Day. The disease has now reached it's most virulent form, and friend K4LHB has been infected as well. This results in such things as operating the Ianuary VHF Sweepstakes from mountain-tops, impromptu trips to investigate various high places, and even the expenditure of hard cash for various items which by no stretch of the imagination would be handy around the home station. A great many lessons have been learned (most the hard way) which are presented here for when the bug bites you.

The location: For Field Day, a "DXpedition" to a rare county (that's right, no "r", just "county") or just the urge to get away for a day or a weekend, the main considerations are (1) a quiet location, with a minimum of man-made noise such as ignition, TV oscillator radiation, fluorescent lights, neon signs, etc., (2) a source of power (which may conflict to some extent with the requirement for no noise) and (3) availability for hamming purposes -both accessability and permission to use the location. For VHF operation, add altitude-the more the better. It is best to scout several prospective locations in advance, preferably with mobile gear in operation. Excellent maps are available from the government (Note 1) to aid in determining height and locating access roads. Permission is best obtained by stressing that the use of the location will be in practice for operation on an emergency basis should a disaster strike the area. U.S. and State parks can usually be used, but permission will usually require a prelimi-

nary inquiry followed by a formal letter to the main office, so start early.

What equipment? Portability sounds like the first thing to consider, but experience puts it well down the line, to be considered only in relation to what is available for transportation and operating space. Reliability comes ahead of everything else, and anything that isn't 101% dependable at home should not be taken out where erratic voltage, temperature variations and possible high humidity (not to mention being bumped around a bit) may be encountered. Compatability must also be considered when using gear from several different sources, as frequently happens. Get the interconnections made and checked out in advance.

Power: For any serious operating, 110 volt AC power is still almost a must. If a power line is available, it may well have generally low voltage and poor regulation, so a husky Variac might be necessary. If a "putt-putt" is used, it shoud be checked for correct speed by running an hour or so under full load with an electric clock connected. Compare this clock against WWV or another clock connected to the local power line. The generator should be adjusted so that the clock connected to it does not lose any time, which then assures that the minimum speed (full load) will produce 60-hertz current. Lower frequencies will cause heating of transformers and poor filtering of dc voltages, whereas any higher frequency will have a negligible effect on the equipment. This is also a good time to check for noise from ignition and arcing at the commutator, especially if a borrowed or rented generator is to be used. Plan on a minimum of 100 feet beetween generator and gear, with a hill or other obstruction in between to keep down both electrical and exhaust noise. A voltmeter to watch for extremes of voltage should be in use at all times, plus some means of disconnecting all the gear at once should the generator overspeed or bog down. For this purpose, any old meter with a rectifier diode and enough resistance in series to bring normal voltage to a logical spot (usually center) on the meter scale will serve. Storage battery power is more practical now than it was a few years ago. what with 12 volt systems, alternators, and transistorized de to de supplies, but there are still disadvantages such as forgetting to start the car before the battery runs down too far. Dry cell power is obviously impractical unless the only means of access is on foot, which makes this type of operation not worth the trouble unless you can find a very rare location and/or a goshawful high hill.

Antennas: The usual things apply here, but everything is temporary, so lots of rope can be used to put things up and hold them there. On a hilltop, there is rarely any benefit to be gained by going any higher than is necessary to get the antenna away from ground effects. For some locations, it is practical to set up the antennas a day or more in advance, since this usually amounts to almost 50% of the work of setting up. For large operations, it is best to select the best qualified "antenna engineer" to oversee the whole operation, including checking that feedlines and rotor control cables are connected before giving permission to "hoist away". My previous article on antenna raising in 73 for November 1964 gives many ideas that will help get the antennas up in the air with the least colorful language and damage.

Spare gear and parts: Anything available can be taken along to keep the station on the air if the main gear fails, but this can be carried to extremes. For example, a Gonset Communicator makes a real nifty spare for 6 or 2 meters, whereas another transmitter, receiver, modulator, and power supplies for all would be practical only if you had an exceptional amount of space available. It is probably best to take a carefully-calculated kit of spare tubes and parts, such as:

- 1-50,000 ohm, 50 watt resistor, with slider.
- 1 each-47 ohms, 220 ohms, 470 ohms, etc., (through 2.2 megohms) 2 watt resistors.
- 1 each-50, 100 and 500 pF and .001, .05 and .01 µF disc capacitors.
- 1 or 2-8 to 20 μF capacitor, rated for highest voltage any of your equipment uses.
- 1 spare for each final amplifier tube, and any other tube that runs in Class "C" or otherwise handles any appreciable power.
- 1 each-5U4 or 5R4 (or silicon replacement); 12AX7, 12AT7, or 12AU7; 6BQ7, 6BK7 or 6BZ7; 6AU6 or 6BA6; 6BE6 and 6AQ5 (or the 12 volt or octal equivalents).

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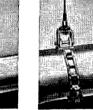
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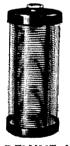




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DEPT. 73

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- Measures 23/4" x 4" x 7" (excluding lens and connectors).
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196-23 Jamaica Ave. Dept. S Hollis, N.Y. 11423

This list will repair, at least temporarily, about 95% of the things that are likely to go wrong with communications gear. It should be modified to include any uncommon tube types or otherwise critical parts your particular equipment uses, but interchangeability should be stressed. For instance, the 12AT7, 12AU7 and 12AX7 all have the same pin connections, and will replace not only each other, but 12DW7, 12AZ7 and quite a few others as well in a pinch. Likewise, resistor and capacitor values are rarely so critical that those listed will not handle any replacement problem.

Shelter: Assuming there is no building at the operating site and you have to operate from a tent or a vehicle, check out the lay of the land before setting up, and take advantage of any features of the terrain that will help with the problems of heat and cold plus wind. As a general rule, "even in summer, hilltops are breezy and" cool at best and can get downright horrible in winter. It is therefore best to arrange for minimum wind, and for that to blow across the gear toward the operators. Since it is necessary to have something to cook on, or at least to heat water for coffee, a stove or heater should be chosen, but to serve primarily to heat the temporary "shack", with cooking capabilities strictly secondary. A kerosene heater, although smelly if not operated properly, seems to do better than the gasoline variety, and presents less of a fire hazard. In summer, mosquitoes and other "critters" become a problem, and all lighting should use the yellow bug-repellent type of bulb. On lower ground, assume that it is going to rain, and set up accordingly so you won't end up in six inches or more of water.

Food: Keep it simple is the word here. Coffee and soft drinks and/or 807's will be the most-consumed items, with not too much solid food consumed. A big batch of stew, chili, or reasonably solid soup prepared in advance, backed up by sandwich materials, is by far the easiest to handle. Frozen foods usually turn out to be a disappointment, since they thaw out before being used and just don't taste right—or conversely, if it's cold enough to keep them frozen, then it's almost impossible to heat properly. Who can operate on half-frozen stuff?

Don't forget's: It is highly frustrating to get all set to operate, and then discover that all but one crystal has been left home, or there are neither speaker nor phones

for the receiver, or no feedline for the antenna, etc., etc. To avoid this, a list should be made up in minute detail of everything that is to make the trip. For example, don't just list "transceiver"; instead list individually the transceiver, power supply, cable to connect them, mike, key, speaker, etc., etc., to be checked off one by one when the gear is loaded. Start the list well in advance and add anything the minute you think of it. Also save your lists from one outing to the next. Items which are usually forgotten are: log and pencils, clock, rotor control box, toilet paper, cooking and eating utensils, small parts of anything which must be dis-assembled.

Miscellaneous: You might think you have picked the most remote place in the world, but if you drove there, so will someone else before your operation is over. I have yet to operate without having visitors, friendly or otherwise, and even the casual ones will usually ask what you're doing. This is the time for the good old public relations pitch, explaining that you are testing your capabilities of providing disaster communications, which you are doing whether you planned it that way or not. This approach is good even in the face of some TVI complaints. However, if you get the "pure ungarbled word" that you are operating on private property, getting into the State Police radios, or some such thing -don't argue or try to make adjustments to the gear. Just apologize, pack up quickly, and leave. Finally, the most important advice of all: Portable operation is meant (like any other hamming) to be fun. Although a fairly business-like approach has been detailed here, it is like waxing the skis, checking over the fishing tackle, or filling the SCUBA tanks. In other words, a little foresight will mean just that much more enjoyment later on.

. . . K3LNZ

Note 1: Index Maps of the various states, showing areas for which detailed maps are available, are available from:

Denver Distribution Section Geological Survey
Dept. of the Interior Federal Center
Denver, Colorado

(States West of the Mississippi, all or part)

Washington Distribution Section Geological Survey Dept. of the Interior Washington, D.C. (States East of the Mississippi)

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Practical Tips on Building Transistor Transmitters

Want to experiment with transistor transmitters? This article gives you the practical information you need.

From recent articles in the ham magazines and on-the-air conversations, it is obvious that interest in transistor transmitters is high. The thrill of working a station on the opposite coast with nothing but batteries for power is hard to beat. Many hams would like to build a solid state rig but shy away when confronted with pages and pages of formulas. I don't know very many good formulas so I'll pass along a few helpful hints and circuits, gleaned from hours of old-fashioned cut-and-try.

Test equipment

Before starting on a transmitter, a simple wave meter to indicate how much rf and at what frequency is in order. A helpful gadget for looking at rf in VFO and low power amplifiers is shown in Fig. 1. The probe end of the shield is not grounded to the gear under test. This unit can be constructed in an evening or so and calibrated with a signal generator. Its calibration is affected slightly by metal tables, etc., so when in use, make it a rule to set it on the type of material that you originally calibrated it on.

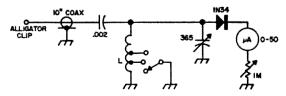


Fig. 1. Simple 3-30 MHz wavemeter-tuned detector useful for checking low power oscillators and amplifiers. L is 30 turns number 20 16 turns per inch, tapped at 14 and 5 turns from cold end.

If you have to purchase a meter, an imported S meter works fine and is pretty easy on the pocketbook. When coupled to a small pickup antenna, window screen, or SWR meter pickup, the wavemeter doubles as a field strength meter for on-the-air checks.

VFO's

VFO and VFO Mixer articles are numerous so we won't go into that. In fact, a stable transistor VFO is probably the easiest part of a solid state rig to build. It is worth mentioning, however, that for an all-band rig, a mixer type setup is easier in the long run. When you consider stability, break in, and calibration, it beats the oscillator-doubler-tripler business hands down.

Power amplifiers

Getting the drive from the VFO up to a useful level to drive a final on more than one band can be a pretty frustrating experience. The class C amplifier works very well with a bare minimum of parts and requires no keying, as the drive determines collector current. Fig. 2 illustrates two common emitter amplifiers. Fig. 2A uses capacitive input coupling, and 2B uses link coupling. An emitter stabilizing resistor can be placed in the emitter lead (bypassed, of course) if you have lots of drive. My experience has been that more output can be realized from a stage by omitting the emitter resistor and using a healthy enough

^{*}QST. September 1964. McKinley. "A Power Saving Conversion VFO."

transistor to hold up under the full output

of the preceding stages.

The tank circuit is the big hitch in a transistor power amplifier. Trying to use tapped coils for a multi-band rig is a little impractical. You wind up with a cabinet full of band switches and Miniductors, not to mention burned fingers and strained eyes trying for the best impedance match. Fig. 3 shows an interstage tank circuit using an Ami-Tron toroid that is fairly easy to build and works, too. This approach combines good Q, power transfer, and impedance matching, all in one neat little package. If you're a miniaturization nut, the toroid will fit in with your schemes nicely, as it is relatively unaffected by nearby components. The large Ami-Tron "E" core is used. Two or three turns will suffice for the links. The number of turns for the links are a compromise for all band operation. If the best impedance match is used for the highest band where operation is intended, the circuit will tend to provide equal output on the lower frequencies. Transistor gain dribbles off at higher frequencies so we shoot for the best match here. A single section broadcast capacitor works well for the tank capacitor and is available for 98c or so from many mail order houses. With 365 pF it is possible to cover two bands on the same tap so be sure to check output frequency with the handy wavemeter.

Output tank

The same arrangement can be used for output circuits with good results. Slight variations will improve the versatility. First, the use of a large tank capacitor will help maintain a decent Q. A double (700 pF) BC variable works nicely with just a few turns on the toroid. Link coupling can be used to the antenna or closer match can be obtained using a sort of sliding tap with capacitors as shown in Fig. 4. Loading up with three knobs is only one step above plug in coils as far as conveniences goes, so a differential capacitor is recommended for CIA and C1B. Since not everybody has one of these things nor the inclination to buy one, you can manufacture one from two identical stators bolted face to face on the same base plate with a common rotor. A close look at some old bolt-together type capacitors might reveal manufacturing provisions for this type of arrangement. (Now you know what all those extra holes in the ceramic are for.) If all else fails-two capacitors can be ganged to achieve the same

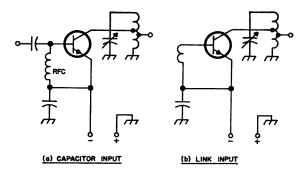


Fig. 2. Class amplifiers. Both are common emitter amplifiers.

effect. The idea being to have CIA decrease with a corresponding increase in C1A and vice versa.

What transistors?

One look at a transistor handbook and the dazzling array of a couple thousand types is almost enough to make you throw in the towel right there. Several articles have been written on choosing a suitable type for rf work so I won't elaborate (too much). The best low power (VFO, follower, etc.) type I've run across is a small NPN found on garden variety 3 by 5 surplus IBM cards at three cards for a dollar. A whole fistful of these for a dollar is an outstanding buy -especially with inflation upon us. If you go for higher power (say you want to light a No. 47 pilot lamp), I'd suggest the RCA 2N3053. These will stand 5 watts cw with a small clip-on heat sink for quite a while. I can't say how long because the originals in my rig are still there. Two in parallel will put a pretty healthy signal on the air and they're cheap—99c at last count.

Circuits and Construction

All the rules for regulation tube transmitters as far as shielding-layout, etc., apply to transistor rigs as well. They do have a few quirks, though, that we must consider. A common ground connection is a must because of low impedances involved. Along

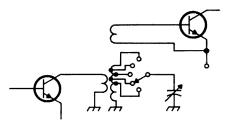


Fig. 3. Toroid tank coil and matching circuit. The links are one or two turns on the toroid. Tuned winding data is supplied with the toroid.

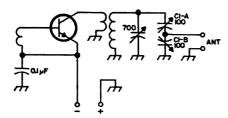


Fig. 4. Final amplifier using a toroidal tank coil and a versatile collector and antenna matching scheme.

this same line, use large bypass and decoupling capacitors. .1 μ F is not too big. Most power transistors have the collector connected to the case so it is a good idea to check this before you go to all the trouble of installing your heat sink on the chassis.

Designing around a positive chassis is a good idea. That way you can use NPN transistors and ground one side of your tank circuits. High gain NPN rf transistors seem to be easier to come by than PNP's.

Power supplies

Whether you use batteries or the AC line is up to you. I prefer batteries for their good regulation and portability. Since buying dry cells gets a little old after a while, for a rig over 5 watts, a couple of cheap car batteries and a charger make a good setup for home use, though a little unsightly. A trip to your local Honda dealer will produce some small plastic cased motorcycle batteries that will perch nicely behind your rig in a small poly tray, the latter being filched from your ever-patient, ever-sighing XYL. A 2 ampere-hour 6-volt size costs around \$4.00 and is good for many hours of operation with a 10 watt cw rig.

I hope the foregoing tips will make it easier for those interested to build a workable transistor rig. See you on 20 with your peanut whistles!

K0CIF

The Drano Finish

One of the nicest finishes that the home constructor can put on an aluminum chassis or panel is an etched finish. Normally this is done in a lye bath, but a much simpler approach uses materials which are normally available in the average household. Lye can be purchased in many grocery and hardware stores, but because it is dangerous, most people don't want to keep it in their homes. On the other hand, Drano is found in most kitchens and will provide the same results as the lye bath.

To etch the surface of an aluminum chassis or panel, the item to be etched must be absolutely clean. This may be accomplished by removing all the oil, greasy fingerprints and dirt with lacquer thinner, followed by a bath in hot, soapy water. Be sure to rinse the aluminum well in hot running water after cleaning; any traces of lacquer thinner or detergent which remain will result in an unevenly etched piece.

A large enameled pan or plastic mixing bowl is required for the actual etching process; the etching solution will attack most other materials. Be sure to select a container that is large enough so that the item to be etched may be completely submersed in the solution. To prepare the etchant, mix approximately two tablespoons of Drano with each quart of water required to fill the container. Use the hottest water that is available from your kitchen tap; the hotter the solution, the faster it will work.

To determine how long the aluminum should be left in the solution, a small sample should be etched before the chassis or panel is tried. This is because the required etching time is dependent upon many variables, including the type and hardness of the aluminum, the temperature of the solution, and the mineral content of the water. In some areas where the water is extremely hard, it may be necessary to use distilled water to obtain an evenly etched surface.

When the etching time has been determined, place the chassis in the solution and wait the required amount of time; make sure that it is completely submersed in the solution. Do not put your hands in the solution when it is time to remove the chassis, use tongs or rubber gloves. This type of solution is quite strong and will result in severe burns where it touches the skin. After the item is removed from the etching solution, thoroughly rinse it off in hot running water. The resultant finish is pleasing to the eye, mar resistant and long lasting.

. . . Jim Fisk W1DTY

A Phase-Locked UHF Microwave Oscillator

Philip Moldofsky K30JK Michael Paolini Jerrold Electronics Corp. Philadelphia, Pa.

Even if you don't expect to build this stable oscillator, you'll likely find the description of it interesting. It provides stability within 1 Hz at even 6.25 GHz.

The solid-state oscillator described below provides up to two watts output with rockstable frequency control from approximately 400 to 900 MHz and can be tuned for second harmonics up to approximately 1800 MHz with as much as 500 mW out. The power and the phase-locked frequency stability on both fundamental and second harmonic frequencies are well suited to a receiver local oscillator (requireing only milliwatts), an oscillator in a frequency multiplier chain, or a UHF or microwave transmitter.

By appropriate switching, the oscillator may be freerun or phase-locked to an external reference oscillator. There is also provision for an external discriminator, so that AFC may be substituted for phase-locking (APC). For simplest construction and operation, the oscillator can be run without either method of automatic frequency control, and this one-transistor, freerunning oscillator will drift less than 30 KHz (at about 600 MHz) in a fairly constant room temperature. Under AFC the frequency will be held

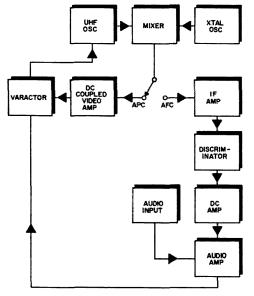


Fig. 1. Block diagram of the oscillator with various means of frequency control.

constant while the signal may be FM voice deviated. In the phase-locked mode, the oscillator can be used as a receiver local oscillator or as a CW transmitter, and the UHF output is locked *precisely* on a crystal harmonic. The phase-locked 400 to 900 MHz signal will be not even one hertz away from the chosen harmonic of your reference crystal frequency.

Circuit

The schematic of Fig. 2 shows the voltage regulating, current limiting power supply and the phase-lock circuitry consisting of the mixer, the video amplifier, and the varactor.

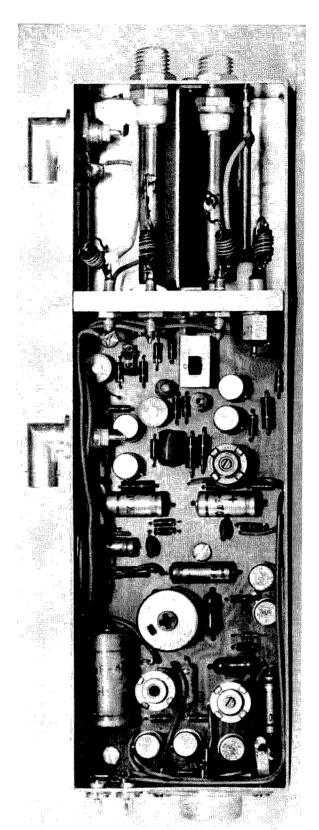
Power required is 25 to 35 Vdc, unregulated, typically at 175 to 300 mA. Also required are regulated +18 Vdc and -18Vdc at approximately 75 mA. The power section of Fig. 2 will provide regulated collector voltage for Q7 from the 25-35 V unregulated and offers an adjustable current limiter. When not oscillating, Q7 will draw damagingly heavy current, so the current limiter is a necessity. The 25-35 V is applied to the collector of Q1 and the regulated output voltage is taken from the emitter through a fixed drop, R3. Now, a variation in the output voltage will unbalance the differential amplifier consisting of Q5 and Q6, applying a restoring voltage to the base of Q3. This is built up through Q3 and Q2 and applied to the base of Q1, turning it further on or off, as required by the original output voltage variation. If output voltage increases, Q1 is turned slightly further off, thus dropping the output. A decrease in output voltage turns Q1 further on, decreasing the drop across it, and bringing up the output. Thus, regulated dc is applied to the collector of Q7, the oscillator. The base voltage is held by zener CR3 at 0.7 V. (The transistor may be damaged if the base is at more than 1 V.)

The current limiter consists of O4, which

senses the current being drawn by looking at the voltage drop across R3. The emitter-base voltage depends on the amount of current flowing through R3, so as more current flows, Q4 brings the base of Q3 closer to the output voltage. At a current level set by R4, Q4 will go to saturation and clamp the base of Q3 at close to the output voltage, so that no higher current can be drawn through Q1. R5 assures that even with no resistance from R4 between the emitter and base of Q4, the current will be limited to about 500 mA.

The dotted lines of Fig 2 indicate the contents of and feedthroughs to the tuned cavities. The collector and the base are tuned in twin 50Ω cavities which have the dimensions given in Fig. 4. O7 is a 2N4040 or a 2N4041, the 4040 being a double transistor in one case. With the 2N4040, up to two watts may be obtained on the fundamental frequencies from about 400-900 MHz and the cavities may be tuned to put out up to about 500 mW on second harmonics. Using the 2N4041, these power outputs are approximately halved. The circuit is the same for either transistor, so the choice is dependent only on cost and power desired. The output is taken from a coupling loop in the collector cavity. If the load into which the oscillator is working is highly non-linear, such as a varactor or a step diode, it may be necessary to provide a 2 dB attenuator at the output. Although this cuts output power by about 1/3, it does provide some isolation, which may make the oscillator easier to bring on when working into this special type of load. The 2 dB attenuator is made of three resistors, as shown in Fig. 2, and placed near the output BNC connector in the collector cavity. Ordinarily, when feeding into an antenna or working into a receiver circuit or any other load that is not highly non-linear, the attenuator is not needed.

The circuitry described above is all that is required for a freerunning oscillator. For frequency control, either AFC or APC may be used; Fig. 2 gives a complete schematic of the APC, or phase-locking, circuit. For AFC, refer to block diagram Fig. 1. The blocks supplied for AFC by the circuits of Fig. 2 are UHF OSC, MIXER, DC AMP, and VARACTOR. The external IF AMP and DISCRIMINATOR may be connected between TP2 and TP1 with the switch in the TP position; TP2 is then the mixer output and TP1 the dc-coupled video amplifier input.



UHF-microwave phase-locked oscillator.

Phase-locking is accomplished in the following way. A pickup wire from the collector cavity feeds a portion of the oscillator output into the mixer, to be mixed with the output of an external crystal reference

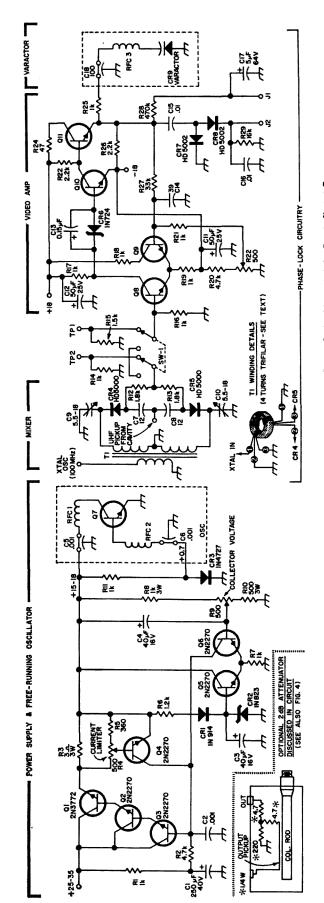


Fig. 2. Schematic of the power supply, UHF-microwave oscillator and APC loop. Dotted lines indicate feedthroughs to or parts located in the cavities. For cavity tuning elements, see Fig. 4. CR9 is a Motorola MV1864B, Q7 is a TRW 2N4040 or 4041, Q8-Q11 are 2N3866 (preferred) or 2N2270, 2N697 or 2N914. RFC1-3 are 6 turns #30 DNB on 1/4" phenolic form spaced to 3/8", and T1 is 4 turns #30 DNB trifilar wound on 1/8" to 1/4" diameter powdered iron core.

oscillator, fed in through T1. We should like the external crystal oscillator to operate at as high a frequency as possible, since the available phase-lock frequencies will differ by the crystal frequency. It will be easier to determine (by a method to follow) the phase-locked operating frequency if the possibilities are 100 MHz apart than if they are closely spaced and numerous. Also, with higher reference frequencies, we can lock on lower order harmonics and take advantage of their higher power. We used a crystal reference frequency of 125 MHz and recommend something on the order of 50-100 MHz. Of course, if you have in mind an exact phase-locking operating frequency, your crystal frequency must be a subharmonic (e.g., for 432 MHz you might use a 54 or 144 MHz crystal reference oscillator). Between ¼ and 1 watt are required from the reference oscillator on its fundamental frequency. When SW1 is in the phase-lock position, the mixer output is fed into a decoupled video amplifier. The operating bandwidth of this amplifier determines the lockin frequency range. For example, our amplifier went out to 10 MHz before it dropped off considerably, so the UHF oscillator tuning elements (including the internal capacitance of O7) could be tuned up to 10 MHz above or below lock-in frequency and the resulting error signal from the mixer would

Transistor	Collector	Voltages Base	Emitter
		23.2	22.6
Q1	25-35		
$\mathbf{Q2}$	25-35	23.8	23.2
$\mathbf{Q3}$	25-35	24.4	23.8
$\mathbf{Q4}$	24.4	25	25
$\mathbf{Q5}$	17	6.5	6
$\widetilde{\mathbf{Q}}6$	27	6.6	6
Q7	15-28	0.7	0
$\tilde{\mathbf{Q}}8$	6.3	0	-0.8
\mathbf{Q}_{9}	12	0	-0.8
$\overline{Q10}$	8	-17	18
Q11	1.7	8	8.5

Fig. 3. Typical transistor voltages. Measurements made with oscillator phase-locked and putting out 800 mW. Voltage on collector of 2N3772 (QI) was 28 V.

still pass through the video amplifier, reach the varactor, and continually keep the base

tuned to precisely nfxixi.

The choice of transistors Q8-Q11 depends on desired lock-in range. We used 2N3866's to achieve the 10 MHz usable amplifier bandwidth. However, if smaller lock-in ranges will be satisfactory, or if external AFC is used and the amplifier will pass only audio frequency deviation, 2N2270's, 2N697's, or 2N914's may be used with no other circuit changes. The amplifier, using 2N3866's, had 30 dB of voltage gain.

Now, with APC switched in at SW1, if the UHF output frequency starts to drift nfxta1 (phase-lock frequency), phase-lock loop sees this attempt to leave frequency as an attempt to go out of phase with the crystal oscillator signal. The mixer immediately puts out an ac error signal, which passes through the video amplifier and is applied to the varactor, keeping the UHF oscillator continually on the phase-lock frequency. For example, if the oscillator is tuned 3 MHz from lock-in frequency when it is turned on, the phase-lock loop senses that the signal is trying to go out of phase with the crystal oscillator at a 3 MHz rate, and retunes with the varactor immediately. While operating phase-locked, the output frequency can be no more than 1 Hz away from nfxta1. (If the crystal oscillator drifts, the phase-locked UHF output will, of course, follow the drift.)

Construction

The entire unit-power circuits, phaselock loop, and twin tuned cavities—was built in a copper box, 8½" x 2½" x 1 5/16". An etched circuit board made this tight construction possible, but etched circuitry is not absolutely necessary. The copper box serves two purposes; it provides a heat sink for Q7 and it forms four walls of the cavities. For best operation, a copper, brass, or aluminum block should be used as the combination heat sink-cavity wall. (See Fig. 4.) However, the four other walls of the cavity (and the other walls of the box) may be fabricated from copper clad board. Skin effect makes the wall thickness unimportant. If copper clad is used, all corner seams must be completely closed with solder. Such a box will not be as sturdy as one formed from 1/16" copper, but it may be more easily fashioned.

The power and phase-lock circuits may be housed in any chassis, but the dimensions of the tuned cavities must remain those of Fig. 4, with the possible exceptions noted in the following paragraph. Whatever type of construction is used (etched circuits, etc.), leads of the crystal oscillator input to the mixer and UHF pickup loop from the cavity should be short. This means placing the crystal oscillator input BNC connector and the components of the mixer (Fig. 2) close to the cavity.

For construction of the twin tuned cavities see Fig. 4. The two leads of Q7 shown are the collector and the base, which are soldered to the ends of their respective tuning rods. The two emitter leads should be soldered to the grounded dividing wall, with leads as short as possible (less than ½"). If sheet copper is used, a flange along the bottom of the dividing wall may be used for support. With copper clad board, the dividing wall may be soldered to the other walls on three sides. C_{*} and C_b are concentric cylindrical capacitors, with a range of about 1.5-7 pF.

However, it may be useful to obtain similar capacitors with larger ranges, which will be desirable to reach lower frequencies. When Ca and Cb are 1.5-7 pF, the oscillator can be tuned as low as about 600 MHz. To reach lower frequencies, the length of each cavity may be increased, along with the tuning rod in it. To fit the tuning rods to various cylindrical capacitors, the rod diameter may be varied slightly, but the cavity height and width must also be increased in proportion of maintain a 4:1 width-to-rod diameter ratio (e.g., 1¼": 5/16"). To tune as low as 400 MHz, the cavities should be stretched to hold rods 11 cm (4.3") long, and C_a and C_b should each have a range up to about 40 pF (which may be partly from the variable and partly from a fixed TCZ capacitor between points A and B and between C and D of Fig. 4). Concentric cylindrical capacitors are made by the Johanson Co., 400 Rockaway Valley Rd., Boonton, N. J. and by JFD Electronics Corp., Brooklyn, N. Y. 11219.

The varactor, located in the base cavity, is coupled to the base by the varactor's supporting rod and by an extra loop of insulated wire that may be brought closer to the base tuning rod. The varactor rod must be kept above ground, so the construction of Fig. 4 is used. The rod fits snuggly into a hole in a piece of Teflon, or other insulator, shaped as pictured. This, in turn, is mounted in the cavity wall. The hole for the copper rod is deeper than will be necessary to accomodate

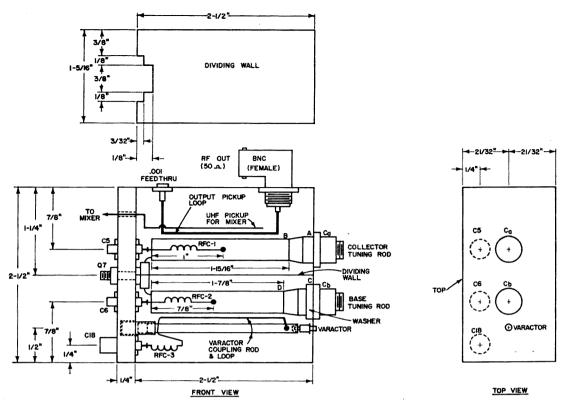


Fig. 4. Twin tuned cavities. See text for details on tuning capacitors Ca and Cb and for information on points A—D. The base and collector tuning rods are hollow brass tubing, 5/16" O.D. and the varactor rod is $\frac{1}{8}$ " diameter solid copper. The varactor coupling loop is insulated wire, about #26. The output coupling loop may be #18 insulated wire or a $\frac{1}{4}$ " brass strip, insulated by spaghetti, and the UHF pickup is #22 insulated wire.

it. This facilitates locking the varactor in position by pushing the rod into the Teflon, then backing out until the varactor is held between mounting holes in the rod and the opposite wall. A dab of solder on the rod, just outside the Teflon, now secures the varactor rod by preventing it from reentering the teflon.

The leads from the three chokes entering the cavities are soldered to the Teflon end of the varactor rod and to the collector and base rods at the places indicated in Fig 4. 50Ω BNC connectors are used for the crystal oscillator input to the circuit and the rf output from the cavity. This completes construction of the twin tuned cavities.

Tuning up and operation

The procedure for tuning up the oscillator consists of first checking out the power supply, then giving power to Q7 and adjusting the twin cavities to resonance. Once the oscillator is freerunning, the mixer is balanced, the video amplifier given power, and the varactor reverse bias set. Methods of determining when the oscillator is locked on frequency are discussed, as well as

methods of determining frequency of the UHF output.

When the power and freerunning oscillator circuits are completed, disconnect RFC1 and RFC2 from feedthrough capacitors C5 and C6. Caution: You must not apply power until Q7 has been taken out of the circuit by the removal of these two chokes. If the power supply is not working properly, Q7 could easily be burned out. (There should never be more than 1 V on the base or 28 V on the collector.) With Q7 thus disconnected, apply the 25-35 Vdc as in Fig. 2. Place SW1 in the TP position and do not yet apply the plus or minus 18 V. Measure voltages at the base and collector feedthroughs to the cavities. The collector voltage should be set with R9 to the highest voltage possible in the range 15-28 V. Now, the base should be at 0.7 V, held by zener CR3. With these two voltages correct, you can test and adjust the current limiter as follows. Choose a resistor to place between the collector voltage and ground so that about 600 mA would flow through it

$$(R = \frac{Vcol}{0.6}).$$

Place this resistor, which should have a rating of about 20 W, and a meter with a 1 A scale in series between collector voltage (at C5) and ground. The resistor is to protect the meter if the current limiter is not working. Now, you should be able to vary current through the meter with the current limiter pot, R4, from about 200 mA to 500 mA. R5 sets the 500 mA limit as explained under "Circuit". After checking that you have approximately the correct range of current limiting, set the pot for a reading of 350 mA on the meter. That should be ample current for normal operation. Disconnect the meter and its protection resistor. The current limiter must work to prevent Q7 from drawing damaging current when it is not oscillating.

With current limiter and collector and base voltages set correctly, and the phaselock switch in the TP position, reconnect the two chokes, thus applying power to Q7. Unload the cavity tuning rods by backing off the output pickup loop from the collector and the varactor coupling loop from the base. Neglecting output frequency for the moment, tune the collector and base capacitors (C. and C. in Fig. 4) for most power out as indicated on a power meter or a receiver connected to the output BNC connector. Now, move the output pickup loop closer to the collector rod for maximum output. If the Ca and Cb used had ranges up to 7-10 pF, the frequency of your initial you have determined, with the power meter or receiver, that the oscillator is freerunning, you are ready to tune to within the phase-lock frequency range and set up the phase-lock loop.

We tuned up using a Hewlett Packard Spectrum Analyzer, which allowed us to tune for frequency and peak power with no trouble. However, as this instrument is not commonly available, the following procedure may be used to determine output frequency. Of course, if a calibrated receiver is available, it may be used to determine frequency and the method below may be disregarded.

To complete the adjustment of the oscillator and phase-lock loop you will need a scope, an rf signal generator (such as Heathkit IG102) or a receiver, and a vom. The higher the frequency response of the scope, the easier it will be to locate your operating frequency, but a 5 MHz scope will be adequate. The method of frequency

determination when a calibrated receiver is unavailable consists of mixing the output with harmonics of several known frequencies from the signal generator and looking at the mixer output on a scope. A few signal generator frequencies will uniquely determine the oscillator output frequency. A more than adequate mixer circuit is the one in Fig. 2, consisting of T1, C7-10, CR4-5, and R12-14. It is advisable to build another mixer (besides the one you will use in the phase-lock loop) since, later, you will want to make frequency measurements while using the original mixer in the loop. Feed the signal generator into T1 ("Xtal Osc In" of Fig. 2) of this extra, test mixer and balance the mixer by adjusting C9 and C10 for O Vdc (±about .02 V) as read on a vom at TP2. Now, feed in the freerunning oscillator output between the two 12 pF capacitors, and look at mixer output (TP2) on the scope. If you are using a low frequency scope, a harmonic of the signal generator frequency will have to be relatively close to the oscillator frequency before you will see a sizeable trace on the scope. An example of frequency determination in this way follows. Tune the signal generator from, say, 100 to 150 MHz. Assuming that the freerunning oscillator is operating in roughly the range 600-750 MHz (for this example, say, 600 MHz), as you tune the generator you will see a mixer output on the scope as you approach each subharmonic of the oscillator frequency (here, 100, 120, and 150 MHz). When the mixer shows a sine output, tune the generator harmonic to zerobeat the oscillator (indicated by a straight line on the scope that becomes a sine wave upon tuning the signal generator either up or down slightly). Thus, if you find a zerobeat at 100 mc on the signal generator, you know the oscillator is operating at either 600, 700, 800, or 900 MHz. (With 7 pF maximum for C_a and C_b the cavities will not resonate below about 600 MHz. If your tuning capacitors have a higher range, the possible frequencies of this example would also include 400 and 500 MHz.) Now, to determine which of these harmonics is the actual operating frequency, tune the signal generator for a zerobeat at another frequency. In this example you would find one at 120 MHz. Since the only one of the 100 MHz harmonics that is also a harmonic of 120 MHz is 600 MHz, the operating frequency has been uniquely determined.

Now that you know the frequency of the

freerunning oscillator, you know which way and how far to tune the cavities to reach the desired harmonic of your crystal reference oscillator. Replace the signal generator with your crystal oscillator and use the above frequency determining method (or use a calibrated receiver) to tune first the base, then the collector slightly, alternating the tuning until the freerunning oscillator reaches the desired reference crystal harmonic. (Turning the capacitor screw in adds capacitance, lowering the frequency.) If it is desired to tune below about 600 MHz, the 12 pF fixed TCZ capacitor (Centralab) added to each cavity may be replaced with a TCN (negative temperature coefficient) or a positive temperature coefficient capacitor to compensate for any local heating effect you find. We did not find compensation necessary. In any case, keep the capacitor leads 1/16" or less. When the oscillator is freerunning at the desired harmonic of your reference oscillator, you are ready to adjust the phase-lock loop.

Begin by balancing the mixer. With all power to the circuits of Fig. 2 off and the crystal oscillator signal (1/4 to 1 W on its fundamental) into T1, adjust C9 and C10 for OVdc (± about .02 V) on a vom at TP2. Now, connect plus and minus 18 Vdc as indicated in Fig. 2. Adjust R22 for approximately 9 Vdc on the varactor. You can measure this directly between C18 and RFC3. The range available by adjusting R22 should be about 6-16 V. Place SW1 in the APC position and turn on the oscillator power. If the oscillator was freerunning near a lock-in frequency (nfxtal), it may come on phase-locked. If not, tune the base and collector until it does lock. To determine when the signal is phase-locked, place SW1 in the APC position and look at 12 on a vom. The mixer will have no measurable ac output throughout the lock-in range Therefore, (while locked, $nf_{xtal}-f_{osc}=0$). there will be no ac on the varactor and no de indication of varactor ac at J2. If the oscillator is phase-locked, you should be able to tune the base and the collector slightly (the collector will affect frequency less than the base) with the voltage at 12 remaining a constant minimum. At the same time, the voltage at J1 will vary as you tune. If you tune far enough to jump out of lock, the mixer will put out an ac error signal and the de indication at J2 will no longer remain constant as you tune, but will vary as you go farther from lock-in frequency. Using J1 and J2 in this way, you can determine when the oscillator is phase-locked.

To determine the extent of your lock-in range, tune the oscillator one way until it jumps out of lock. Use the previously discussed method of frequency determination to measure the output frequency at this point. Now, tune back through lock-in range until the oscillator reaches the other lock-in range limit and jumps out of lock. Measure this frequency. The difference between the two range limits is the total lock-in range. This range may be increased by (1) placing the varactor coupling loop closer to the base tuning rod, (2) lowering the dc reverse bias on the varactor with R22 (but do not go lower than about 6 V), or (3) placing the UHF pickup loop closer to the collector tuning rod.

One further method of increasing lock-in range is to improve the frequency response of the video amplifier. This may be accomplished by decreasing the feedback, thus increasing the gain, at high frequencies with a larger value of C14. With 2N3866's for Q8-Q11, and 39 pF for C14, the response was 6 dB down (or 2:1 in voltage) at 10 MHz. You may measure the frequency response of your amplifier by placing SW1 in the TP position, connecting a signal generator at TP1, and noting on a scope the amplifier output at the C18 end of R25 as the generator frequency is run up to about 10 MHz. Do not forget to take into account the frequency response of your scope.

When you have the desired lock-in range (probably plus or minus about a megacycle for CW operation, or 20-50 KHz if the video amplifier is to be used only for audio deviation in conjunction with an external AFC circuit), check the output on the power meter or receiver. Output power may be increased with larger collector voltages (but do not exceed 28 Vdc) and with tighter coupling of the output pickup loop to the collector. Also, make sure that the current limiter is not holding the power down. The current limiter should be set so that increasing the limit does not appreciably increase power output. Again, about 350 mA should be sufficient for normal operation.

With reasonable power out and the desired lock-in range, adjustment of the phase-locked oscillator is complete.

Application and results

As mentioned, the oscillator can be run in three modes-freerunning, phase-locked,

or AFC (with external circuity). This article is centered, as were our applications, around the phase-locked oscillator. We spoke, in "Circuit", about connecting an external if amplifier and a discriminator between TP1 and TP2 and using the dc coupled video amplifier, the oscillator, mixer, and varactor of Fig. 2 to accomplish AFC. (See Fig. 1.) Such a hook-up will allow FM voice deviation, Using any if frequency and any discriminator, tube or solid state. We also tried running the oscillator CW in the phase-locked mode as a CW transmitter, in a frequency multiplier, and as a receiver local oscillator.

Used as a phase-locked CW transmitter, we need a method of keying the oscillator. Not wishing to turn Q7 on and off, heating and cooling it, we keyed the rf output. By running the output through a cable with a BNC "T" connector in it, we can key the signal by keying a capacitor directly across the open "T". (See Fig. 5.) We found that a small 1.5-7 pF trimmer across the length of the BNC "T" resonated at about 600 MHz, placing an effective short across the output. This does not damage Q7 and we were able to tune the trimmer for a 30 dB difference (1000:1) in power output between "key up" and "key down". You may

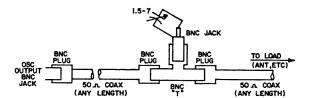


Fig. 5. Keying the oscillator by means of a tuned short across the output.

wish to try other methods of keying by shorting the output, such as a biased diode across the line, where the bias is keyed.

For those considering using the phase-locked oscillator as a receiver local oscillator, the S/N ratio is at least 70 dB at room temperature, for a 30 MHz bandwidth. The low noise aspect of the oscillator may interest radio astronomy enthusiasts, as the oscillator's second harmonic range includes the 1420 MHz hydrogen line and other atomic transition frequencies.

As the stable oscillator in a frequency multiplier, results were very good. Using a varactor multiplier we obtained 40 mW at 6.25 GHz (for a receiver local oscillator), taking about 300 mW from the phase-locked oscillator at 625 MHz. 625 MHz or 6.25 GHz, plus or minus not even 1 Hz, is something to think about.

. . . K30JK

Improving Tube-Socket Mounting Holes

Many retainer-ring-mounting tube sockets, such as the Amphenol Type S, have a number of notches on the edge. A tab on the edge of the mounting hole is supposed to project into one of these notches and prevent the socket from turning. This tab is commonly produced by a special socket punch which is quite expensive and not readily available. However, a hole produced by a conventional socket punch can be easily equipped with a tab, as shown in the photograph. From the material removed by the socketpunch, cut a piece 3/16 inch wide. Bevel the corners at one end so that it will fit the notches in the socket. Then fasten the piece to the underside of the chassis in the desired position with solder or epoxy cement. The tab will not interfere with the insertion of the retaining ring if the material is not overly thick.

Miniature-tube sockets using retaining rings require a flat in their mounting hole to prevent them from turning. This can be provided by a similar technique.

. . . Charles Cohn



73 Tests the Eicocraft Code Oscillator



Here's the way the kit comes.

Eico is well known for its excellent electronic kits. I've built a number of them, including a stereo amplifier and 460 scope, and found them very satisfactory. Their new transceiver kit has received a lot of attention, and many hams have bought, built and used them.

A new Eico venture is a line of inexpensive kits for the hobbyist and experimenter. You'll see these kits in many electronics stores around the country. Among the Eicocraft kits are a fire alarm, intercom, burglar alarm, light flasher, siren, metronome, tremolo, audio power amplifier and ac power supply. They range in price from \$2.50 up, but not very far.

We received an Eicocraft code practice oscillator kit for test, and decided that the fairest test would be to have a person with no knowledge of electronics build the kit. Looking around the office for a suitable person, my eyes fell on the cute 18-year old girl who helps out in our subscription department. Judy agreed to try the kit, and she took it home to work on. I later heard that she'd had some problems, mostly with her husband, who wanted to build the kit,

but she finished the kit and it worked properly. Here are some of Judy's comments:

It wasn't too difficult to assemble the solid state electronic code oscillator. The instructions were quite easy to follow. Most parts were simple to identify and position, however, some were poorly labeled. With the use of both the diagrams and the assembly procedures, I eventually figured each one out.

Being quite unmechanically inclined, I found soldering to be the most difficult phase of the project. Just anybody certainly couldn't use a soldering iron without some basic instructions or some samples to practice on in order to avoid ruining the kit. The instruction sheet seemed to be lacking here.

I also had some problems with connections to the board from the speaker, key and battery since I didn't know how to strip wire. However, I did get the wire stripped after a few tries. Then I connected them all up and pushed the key. It worked!

And a few other notes. The parts were all of good quality and the oscillator worked fine and emitted a loud, clear tone. I'm sure that any budding electronics hobbyist would enjoy this kit and many of the others in the line.

. . . WA1CCH



Judy working on the Eicocraft code oscillator.

100 Watts Out on Two with Compactrons

Here's a higher power final amplifier for two meters for all of you devoted KICLL followers.

This article just about completes our present series of low cost transmitters up to 100 watts output for six and two meters using today's tubes¹. Here is a transmitter for two meters which can put you well out of the 2E26-6146 class. Two 7894 Compactrons can put out 100 watts on two with high level modulation.

Considerations

Some interesting thoughts occurred on VHF transmitter design while working on

1. Six Meter Heterodyne VFO Transmitter, April 1965. Compactron Two Meter Transmitting Converter, September 1965.

4X250 Transmitter for Six and Two, April 1966. 50 Watts for 50 MHz for \$50, June 1966.

75 Watt Twoer Linear, July 1966. 80 Watts for 144 MHz for \$80, October 1966. All by K1CLL and all in 73, of course.

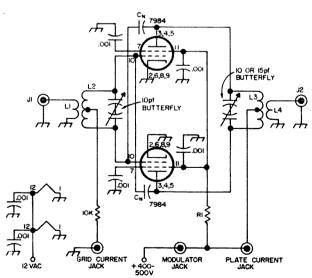


Fig. 1. Schematic of KICLL's Compactron push pull final amplifier for two meters.

this rig. Push pull has been used for VHF for well over 30 years, and ever since the pre-war days the general design for medium power tubes has centered around the double beam power tube with plates on the top and one glass bottle. Examples of WW2 tubes of this type of course are the 832 and 829. Since then a nice new series of this same type (5894, etc.) have come along. However, they are generally expensive and require a fancy socket. I have had the same one in a Johnson 6N2 for about 5 years and like it very well; perhaps because I keep the dc input strictly at 90 watts.

Today we have a new family of single ended tubes, real toughies, with ratings to 80 watts input on 175 MHz. These are the Compactron transmitting tubes with television priced 12 pin sockets that are intended for single ended use as detailed in several previous 73 articles¹. However, as you will see, when you do put them together in push pull, they go like two outboard motors on a racing hull.

Fig. 1 shows the schematic and Fig. 2 the pictorial layout of this amplifier using push pull 7894 beam power Compactrons. Each costs \$5.00 and the pair is rated at a de input of 162 watts in IMS (Intermittent Mobile Service). However, if you run this much power, expect to change tubes every now and then. If you don't want to change tubes every so often, then run 125 to 150 watts input to the two tubes.

Make sure that the two plate lines are the same length and that the grid lines are also equal in length. The neutralizing wires and tabs should then cross over each other and be similar as well.

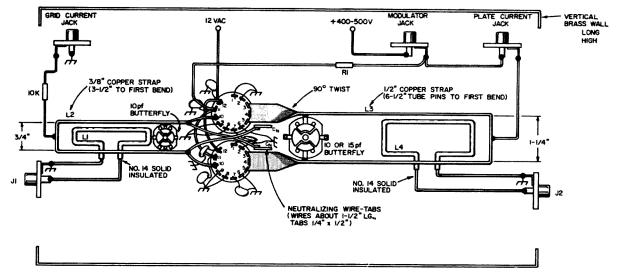


Fig. 2. Layout, coils and details of the two meter Compactron final. This drawing is one-third size.

Solder all eight cathode leads to the chassis, bypass the heater and screen leads with small flat disc capacitors, and you're ready to start "strapping." You can use coils for this type of circuit, but if you have room, lines are preferred. The push pull grid lines showed the usual improvement in length of inductance over the single grid type. Quite a nice tuned circuit was obtained which tuned up very well on two meters.

I obtained 7 mA of grid current through the 10-kilohm grid resistor, dropping to 4.5 mA when the screen and plate power was applied. Naturally some of the electrons which previously landed on the grid are now attracted to the screen and plate by their positive voltages. You should expect that the grid tuning will flatten out a little too. It will!

I tried both small and large size butterfly tuning capacitors on the plate lines, and both worked equally well. For arc-over security, I went back to the larger size.

The neutralization was easy after one or two tries. First I set up an elaborate little brass shield with large holes, subpanel insulator and nice long pins to carry the neutralizing wires through the shield from the grids to the plates. However, I had to go to the shortest possible heavy copper wire, about number 14, directly across the socket from grid one to plate two, etc. Putting 200 mA of plate current and no rf drive on the other tubes, the proper capacitance is easily found by watching for self oscillation with the plate and grid circuits tuned to 144 MHz. The ½ by ¼ inch tabs ended up about ¼ inch from the plate

lines. These tabs are really over the plate pins where they are soldered to the strap lines. Using insulated sticks, move the tabs nearer or further away from the plate lines and you will soon find the best place for both wires and tabs. The tabs, to be more explicit, are over the first ¼ inch of the plates lines. Half of each plate pin is bent over so it presents a flat surface to be soldered to the strap, and right over these points and about ¼ inch away are the neutralizing tabs. After the neutralization is completed, there should be no self-oscillation at any point in the 144 to 148 MHz range.

A plate dip of almost 70% was obtained with this amplifier. The pencil arc test with the plate dipped gets pretty hairy with 160 watts input; I would recommend that the pencil be taped onto a dry wooden stick and that the other hand be kept in the pocket. The arc is at least half an inch long. When this plate circuit is loaded it will brilliantly light a 100 watt bulb on two meters. You can use either loop coupling or direct to the 100 watt bulb porcelain socket for a dummy load. I tapped the socket onto the lines about 3¼ inches up from the cold end for maximum loading.

Baluns

Note that the input to the grid circuit has an unbalanced to balanced transformer in it. This is a perfectly legal type of balun and works quite well. Just for a check I inserted two chokes and capacitors in each grid to check the grid currents separately and with considerable satisfaction I found

them both to be exactly 6 mA. Note that inasmuch as I put in another 10 kilohm grid resistor, I now have 5 kilohms for the two grids. Actually the grid resistor turns out to be very non-critical so enough on that.

I tried coupling the exciter to the grids capacitively and by a link, but both methods provided practically identical results.

The final total grid current (both tubes) through the grid resistor was 7.3 mA with no high voltage on, and 6 mA with the high voltage applied. The screen voltage was 135 volts with the plate loaded to 100 watts dc input, and 80 volts with the plate dipped. In that condition fewer electrons land on the plate and more on the screen; probably a little better screen regulation is called for.

The grid bias voltage, developed by the rf drive across the grid resistor, was minus 58 volts with the high voltage turned off, and minus 44 volts with the high voltage on and 100 watts of load.

That's about it except for modulation. Theoretically we need 80 watts of audio to properly modulate the 160 watts dc input. Our standard modulator with a pair of 6L6GC tubes seems to be good for a maximum of 55 watts of audio, so either four 6L6's or a pair of 7894's will do the job. Also, two 807's or a pair of 1625's can put out up to 120 watts. You can see that we're skating near the point where everything gets quite a bit more costly, with 1200 volt power supplies, 811A modulators, big modulation transformers, etc. We'll see later about the cost of a good 80 to 100 watt modulator.

On the air

Hooking up the new double conversion superhet exciter, a commercial modulator, and a 500 volt supply which only gave about 125 watts input, I opened up with more power on two meters than I've had since my kilowatt days in 1949-1950. My little four element beam, two over two, about 10 feet over the roof had to do for now.

The first thing that happened was the number 48 bulb I was using for an rf output indicator nearly burned out. This is across the 50 ohm output antenna cable in series with a 1 to 5 pF capacitor. The trimmer was wide open, so I had to put in a 0.9 watt brown bead bulb which lit to about one half full brilliance. For now I had to lose that half watt. Shifting the B plus lead to the final down on the muli-match modulation transformer to accommodate the lower impedance of the push pull tubes, I listened in to my own voice on the "Amateur's Friend", the diode-amplifierpadded earphone system. It sounded real good so I tuned across the band. W1KI in Lynn, Massachusetts was chatting with a friend, so I switched on the exciter B plus, zeroed the exciter carrier in on the receiver pass band and had my first OSO with the push pull 120 watt rig. Don't forget, you can go to 160 watts if you have the modulator! Please note also that breaking in on two meters is a welcomed procedure.

A word about zeroing in without a BFO. I used to go to great lengths to heterodyne in with the BFO on, until one fine day I realized that the *if* pass band of a good receiver is fine for that purpose. Just leave the receiver tuned to the desired frequency, reduce the *if* and/or rf gain control, watch your S meter and zero in with only the exciter on. It works great; at least for AM phone.

All reports with this new rig were good. Stations that had heard my 50 watter (rf power out), noticed the increase in signal strength. It is a matter of individual taste just how much power you want to run. All those little decibels add up; beam, height, power, etc. This 100 watter gets you quite a way out of the 2E26-6146 class without jumping into the 1000-1200 volt region. There is quite a jump when you get into that class; things get real lethal, costs rise like mad, and size and weight jump too.

Hope to see you on two someday.

. . . K1CLL



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The Poor Man's Occasional Antenna

Here are some very cheap portable antennas that work well.

There are occasions when you want an antenna to use for a short time and you would like not to make a major investment. You'll even settle for something less than optimum. Such situations are representative of the sometimes mobileer, the vacationer in the woods or at the beach, the short time renter and the guy with limited real estate.

The sometimes mobileer

Many of us cringe at the idea of cannibalizing a good automobile. If you live ten minutes from work, mobiling has no attrac-



It's not very pretty, but this temporary antenna both stays on the car at 60 mph, and performs well.

tion as a daily operation. On the other hand you go for a vacation in the summer or a cross country trip for other reasons three or four times per year and you would like to have a mobile ham rig. The rest of the time you could care less.

There are assorted ways of bolting or strapping in or otherwise securing the rig inside the car without permanently marring anything, which we won't go into. But the major problem is the antenna. Any kind of permanent mount involves cutting holes in the body, purchasing an \$8 to \$12 mount and another \$8 to \$12 antenna and mounting same. It is easy to get \$25 tied up in a mobile antenna. Now for 23 cents apiece you can buy a couple of rubber suction cups and for less than \$4 you can buy a 9 foot fiber glass fishing pole blank. If you wrap the fishing pole with the proper amount of wire you can get it to resonate on any band and what's more it will radiate as well as any store bought antenna you might get. For over 30 years W7CSD has been hamming but never before mobile. We decided to give it a try. The photos show the lash up. The bottom is the remains of one section of a GI antenna upon which the fiber glass pole fits snugly with the help of a little bit of tape for shimming. We formed a hair pin of heavy wire around the bolt in the bottom suction cup bringing the ends together and pushing about 6 inches or so up into the metal rod. The top suction cup is "haywired" to the metal rod and a piece of cord is tied to the door

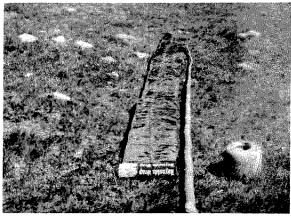


handle to make sure that nothing blows away. Likewise a cord or strap connects to the lower cup and runs under the door and ties to the door handle or window crank inside. Suction cups will hold by themselves up to 60 miles per hour but may come loose at higher speeds. Secured with cord in this way you can travel at any speed. The transmission line is two pieces of RG-59 in parallel which approximates 36 ohms and a good match for the whip. The line is only about 6 feet long anyway. The inner wires connected together clip on to the end of the winding on the pole and the shield clips to the chrome gutter. Windows may be cranked nearly shut or left open. Now about the pole itself. By the well known method of trial and error we decided to wind 16 feet of wire evenly spaced on the pole for a 20 meter quarter wave. We then ran a single turn between the whip and the gutter and placed the grid dipper coil thru the loop. It dipped beautifully at 21 MHz. So we had a 15 meter antenna. We soldered on at this point and wound a few more close spaced turns and dipped at 14 MHz. Actually we can use either tap and we resonate at 21.35 MHz on the top tap and 14.3 MHz on the bottom. We have worked all over the U. S. and one KP4 from W7 land on 15 and 20 meters with this arrangement. However the ignition noise while in motion is as yet an unsolved problem. The second whip wound for 40 meters works equally well and there is no ignition problem. This time we started out with 50 feet of wire and finally wound

the pole four times before achieving the desired frequency. We finally spaced considerably closer at the lower end of the whip. 60 feet evenly spaced would be pretty close. There is no question about getting a dip at the resonant point; it is very positive. Once completed the whole assembly can be installed or removed in a matter of minutes. We have received S9 reports from the Mexican border and the Canadian border both at the same time on 40 meters in the middle of the day. I doubt that a fancy store bought job could do any better.

The vacationer

There are those who go to a beach or mountain cabin and rely on Reddy Kilowatt to furnish energy. Of course the fiber glass whip would work here too. There is no question about it for the higher frequencies the



The makings of an inexpensive (18¢) vertical antenna.

old ground plane is the best bet if you are in a hurry. Of course there are those who still have the old screw together GI whip; they're ok too. Another stunt is to hang a quarter wave of wire between two trees, in a vertical position. A novel idea is to find a 16 foot 2 x 2 or even a 1 x 2 and pull out 16 feet of kitchen type aluminum foil and wrap it length ways around the lumber, clothes pole, sapling or whatever. Support it in a vertical position with some cord guys, string out 3 or 4 radials, connect hot wire to the foil and shield to the radials. With a transmission line of less than 6 feet between the xmtr and the ground plane a 16 foot vertical will work equally well on either 15 or 20 meters. Of course the SWR on 15 will not be good but who cares with 6 feet of line. Any pi net will load into it. We have worked the whole Pacific on 15 with this kind of a lash up. Last but not least is the trusty dipole for low frequencies. One sneaky way is to use some 300 ohm ribbon and run out the necessary 60 odd feet either side of center then clip out a section of one wire at the 33 foot distance and you have a 75-40 meter dipole which will also work very well on 15 meters. Here again let's do it the cheap way. Use 72 ohm ribbon. It looks awful small but actually it will stand about 10,000 volts without breaking down and you can even get away with feeding it a kW. Why mess with bulky and expensive co-ax? You can ground one side of ribbon in your pi network and it will work just as well as co-ax. How do we get it up? Climbing trees is for kids. If you're a kid ok. Otherwise do it some other way. A ball of binder twine is an excellent thing to have any way if you are camping or on a vacation. Throw a hammer

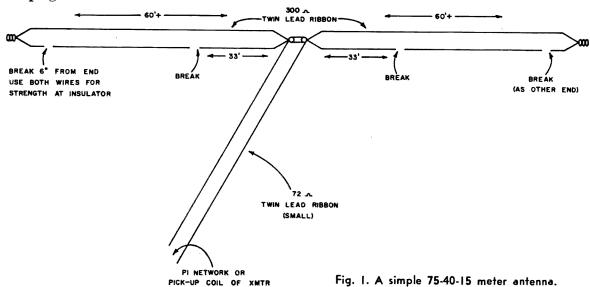
or other weight attached to the twine thru the branches of a tree or over a building and hoist the flat top. If you want to get way up, one method we have found that is very effective is to use a bow and arrow. The arrow will pull a light line over a pretty high limb. Binder twine is cheap enough to throw away when you move on. For a permanent support either for a flat top or to guy a ground plane binder twine loses its strength (and so does polyethylene cord).

The short time renter

The fiber glass whip will work well with a few radials strung out under it in a fixed location. Also the aluminum foil ground plane will last for quite a while if well wrapped. Aluminum pipe is quite reasonable and if you are on the second floor with a short transmission line to the ground plane the 20-15 idea will work here too. Of course an added loading coil would make the lower frequencies available. If the only way to go is up and you are permanently located, irrigation pipe comes in 40 foot lengths. A 4 inch one could easily be erected by two men and would be much cheaper than a tower. A lot of people are bothered by the insulating problems of the ground plane. This is not nearly as serious as one might think. In the first place a ground plane is current fed. The voltage at the feed point is very low. Dry wood makes an adequate insulator. Or better yet boil the end of the post, to support the ground plane, in para-

All of these low cost antennas will work and deliver a good signal. Try one.

. . . W7CSD



Concerning Service on Ham Gear

It has been said that a chain is no stronger than its weakest link. Applying this logic to our ham business and taking all factors into consideration it seemed that customer service was one area that could be strengthened.

Johnny Q. Ham, in these days of sophisticated circuitry, simply hasn't the means to properly service or repair his gear and when it breaks down and needs attention, Johnny wants it done right and promptly, too. (Isn't that contest coming up next weekend?)

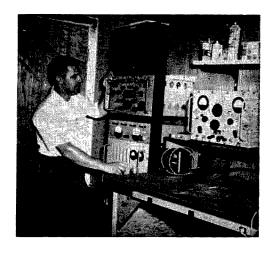
that contest coming up next weekend?)

Here at Harvard we have several strong points going for those who want prompt and correct treatment. We have extremely competent personnel each day and evening. We have the most advanced service facilities and we have a most comprehensive library of original manufacturer's service notes or instruction manuals all arranged to speed our work

and to insure *your* satisfaction.

The people working here are all practicing hams of long experience; they understand your problems and, more important, how to achieve the original manufacturers goals of performance. For example David Schilling has worked on and mothered literally hundreds of R388 and R390 receivers. Charles Branch has a kit of specially made tools for cleaning and restoring, like nothing we have ever seen before, and when Charley cleans up your A4 it will be just like new. Mervin McKee, whose specialty is sideband gear, can quickly null out the unwanted carrier and sideband and run a performance check on the overall gain of your SSB rig. Our newest lad Karl is particularly keen on Swan, National and Gonset's transistorized rigs, and on Collins S lines. All the boys are proficient. Dick Tassone loves mobile installations and he's constantly looking for that perfect noise free job.

Equipment wise we have solid state counters to 15 Gc and accurate to one part in 10⁸ per day (compare that with your BC221),



digital voltmeters, digital ohmeters and HP's 425 micro-micro amperemeter that will measure the energy of a mosquito's flight—that is if we knew enough to harness the critter. The techniques that each person employ are channelled to the kind of job you have for us. The best of Tektronix, G. R., HP and other specialized manufacturers are utilized to advantage.

So fellows if you want your gear serviced even though you bought it elsewhere and you want it done right and quickly drop us a line, or better yet send the piece along with a brief run down of the problem you're experiencing. Our charges are particularly modest considering our investment in facilities: Only \$5.50 per hour plus replacement costs. We're not in the service business but proper service is a necessary adjunct to our ham business.

For those who are considering purchasing new gear, isn't it some consolation to realize that these same service men and facilities are available to fulfill the terms of our warrantee? Very few pieces of new equipment ever need go back to the factory with the time consuming process of service and shipping two ways—causing you needless delays.

Prompt service is a proven factor at this company. Remember also that we sell all standard brands plus a full line of accessories. We're New England's only exclusive ham house.

73 Herb Gordon W1IBY

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Rewinding The Power Transformer

Many radio amateurs feel that the days of rewinding power transformers are long gone, and they may be right in this, but there are still two good reasons for "rolling your own", when it comes to certain cases. These are expense and the fact that transformers for certain voltages are hard to come by.

Actually a transformer is a simple device. It consists of a core, usually laminated iron or steel in a power transformer, and two or more windings of suitable wire wound on the core. The power capabilities are determined by the type of core material, the size of the core, and the diameter or gauge of wire used in the windings.

As an AC voltage is applied to the primary, (the input winding) it causes a magnetic field to expand around the core. That is, the core becomes magnetized. As the magnetic field expands, the magnetic lines of force cut across the secondary or output windings and induces a voltage across those windings. When the input voltage drops to zero as our 60 hertz current does 120 times per seconds, the magnetic field collapses, the lines of force once again cut across the secondary windings and a voltage of opposite polarity is set up across

т	able I
Wire gauge	Current capacity*
10	14.8 amperes
12	9.33
14	5.87
16	3.69
18	2.32
20	1.46
22	.918
24	.577
26	.363
28	.228

*Figured on 700 circular mills per ampere

those windings. The process is repeated again and again as long as an AC voltage exists across the primary winding.

The ratio of the number of turns of wire on the primary to the number of turns on the secondary will always determine the ratio of the voltages of the primary to the voltages of the secondary. This simply means that the following holds true.

$$\frac{\text{TURNS (primary)}}{\text{VOLTS (primary)}} = \frac{\text{TURNS (secondary)}}{\text{VOLTS (secondary)}}$$

Knowing these simple facts and that the power capabilities of a transformer do not change when we rewind it, we can proceed to rewind a transformer, for any special application. Step by step instructions are given.

1. First, figure your power, voltage, and current requirements. A 2½ volt transformer delivering 10 amperes will handle 2½ volts X 10 amperes or a total of 25 watts. This means that you must rewind a transformer capable of handling that much power. Most television transformers are designed to deliver 200 to 300 watts continuously, day after day, and will handle much more power in amateur applications.

2. Remove the shell covers from the transformer and identify the leads. Trace the wires back into the windings. Usually the filament winding for the rectifier tube is on the outside, then comes the 6.3 or 12.6 volt winding, then the high voltage winding and finally the primary or 117 volt winding. These can readily be identified by the color code in *most* transformers.

Green	6.3 or 12.6 volts
Yellow	5 volts
Black	117 volts
Red	High Voltage
Red and yellow	Center tap of HV

While this color code is not always used, a little work with the voltmeter will identify all the windings.

3. Remove the paper covering the first winding and count the turns of that winding. Divide the number of turns by the voltage of the winding. For a typical 5 volt winding, there may be 15 turns. This gives us 15 turns/5 volts or three turns per volt. This ratio of turns per volt will exist on every winding of the transformer.

4. Multiply the number of volts of your new winding by the number of turns per volt found in step #3. In my case I wanted 2½ volts for 866A rectifier turbes so I used 7½ turns on the winding. The size of the

wire needed to carry the current may be obtained from Table 1.

5. Now carefully (hal) remove all the windings you are not going to use. In my case I removed all but the primary. You may want to save the high voltage or a winding already in place. By saving a high voltage winding and adding a 28 volt winding we can build a nice transformer for surplus gear.

6. When you have removed the windings you no longer need, you can disassemble the core. Using a screwdriver, a light hammer, and a pair of pliers, force the E shaped pieces out of the core. Notice that there are about three E's facing one way and then three facing the other direction. The first few E's are hard to remove but the rest are easy. Also save the cardboard caps usually found on the ends of the winding area.

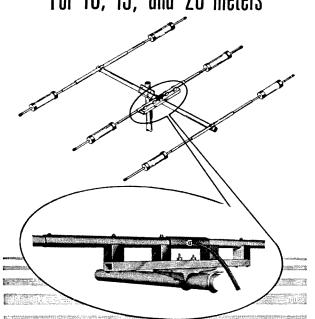
7. Now carefully put on the new winding. Formvar insulated wire is excellent for this and may be purchased at a local motor rewinding establishment or if you can't find it there, order it from Allied. Insulate between each layer of a winding and between the various windings. The easiest insulation I found to use was Scotch #33 tape but you can obtain paper for the same purpose. The winding may be put on by hand or if it is a high voltage winding with many turns, the core may be placed on a wooden block and chucked up in a lathe. Keep track of the number of turns or your face will be red later on. Do not forget your center-tap if you need one. A piece of well-insulated, flexible wire should be used and this solder connection should be taped well.

8. After the new windings are in place, tin the ends of the wire and attach flexible leads about twelve inches long. Now add a final layer or two of tape. In my case, since this winding would carry high voltage DC, I added several layers.

9. We're almost done! Reassemble the core, placing three E's one way and then three the opposite way. The last few will go in hard but use all of the core material. When this is completed, put on the shells and tighten the bolts that hold the transformer together. These will probably have to be retightened later as the transformer is used, until they are completely tight. If they are not tight, the transformer will buzz.

10. Install the transformer, use it, and think of all the bucks you saved by winding your own.

Revolutionary MATCHING The Classic 33 New from MOSLEY For 10, 15, and 20 meters



Yes, here it is from Mosley • • a Tri-Band Trap-Master beam (1 KW AM/CW and 2 KW P.E.P. SSB) featuring a NEW Mosley matching system, "Broad Band Matching" with coax fed balanced element for even more antenna efficiency and additional gain!

This 'Classic' New addition to the Trap-Master family of beams, incorporating the All-Metal encased traps made famous by the original and still extremely popular TA-33 beam, brings you: (1) A front-to-back of 20 db. or better on 15 and 20; 15 db. on 10 meters. (2) A gain of 8 db. over reference dipole or 10.1 compared to isotropic source. (3) A longer boom for even wider element spacing. (4) A SWR of 1.5/1 or better. (5) Priced to fit your budget.

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4610 N. LINDBERGH BLVD., BRIDGETON MO. 63042



The Drake L-4 Linear Amplifier

Jim Fisk WIDTY RFD 1, Box 138 Rindge, N. H. 03461

The new Drake L-4 linear amplifier has just about all the features you look for in a high power rf amplifier. Since this compact unit is rated for continuous duty, it will loaf along at 2000 watts PEP on single sideband, or a full gallon on CW, AM and RTTY in amateur service. The complete L-4 amplifier consists of an rf power unit and a solid state high voltage supply. There is a long connecting cable provided so the amplifier may be conveniently located at the operating position with the power supply tucked underneath out of the way.

The Drake L-4 may be driven to its full rated input on single sideband by any transmitter that has an output of 100 watts PEP. For full input on CW, AM and RTTY, the exciter must have an output power of 75 watts. For maximum efficiency, the 50 ohm input impedance of the amplifier is matched to the grounded grid power amplifier tubes

through a factory adjusted, broadband pi network. There is a separate network provided for each band and when peaked up it will cover the entire amateur band. To cover other frequencies in the 3.5–30 MHz spectrum, these circuits may be adjusted by the operator. This is especially helpful for those hams who handle a lot of traffic on the MARS frequencies. The necessary adjustment is very easy to make and requires only an SWR bridge; the instruction manual gives complete details and the entire procedure shouldn't take more than four or five minutes.

To ensure that the odd order distortion products are suppressed more than 35 dB, a slight amount of negative feedback is obtained in the L-4 by raising the grids above ground with 200 pF grid bypass capacitors. In addition, a very effective ALC circuit is included to prevent overdrive and

Drake L-4 Specifications

Frequency

coverage:

All amateur bands from

80 through 10 meters.

Power input:

2000 watts PEP SSB, 1000 watts dc on CW, AM and

RTTV

Drive

requirements: 100 watts PEP SSB, 75 watts CW, AM and RTTY.

impedance:

50 ohms unbalanced.

Output

impedance:

Adjustable pi network designed to load into 25 to 100 ohm unbalanced loads

(50 ohm coaxial lines with SWR less than 2:1). (50

Tube lineup:

Two 8163 or 3-400Z triodes operated in class B

grounded grid.

Features:

Broadband input circuit on each band for high efficiency with minimum disortion; transmitting ALC; rapid heating filament tubes-3 seconds from initial turn on to full rated input; internal

antenna swiching.

Power

requirements: 230 volts ac, 50/60 Hz at 15 amperes, or 115 volts ac, 50/60 Hz at 30 am-

peres.

Size and

weight:

Amplifier: 13-15/16" X 7-7/8" X 14-15/16"; weight 32 pounds. Power supply: 6-3/4" X 7-7/8" X 11"; weight 43 pounds.

Price: \$695.00

further reduce distortion. A small amount of rf energy is picked off the input and applied to a semiconductor diode which is normally reverse biased. The amount of reverse bias is controlled by the transmitting AGC threshold control, so the point where the rf is rectified may be precisely controlled by the operator. When the rf exceeds this reverse bias, the diode conducts and a negative voltage proportional to the rf signal applied to the grid appears at the ALC output connector. This signal may be used with the exciter through its external ALC input to control audio gain.

The power tubes are matched to the 50 ohm output by a conventional pi network. To maintain high Q and high efficiency, the tank coil is constructed of very large diameter tubing and completely silver plated. A portion of the rf output voltage is rectified and applied to the output meter through a sensitivity potentiometer. This little convenience is very helpful in obtaining maximum output from the amplifier since maximum output does not correspond exactly with plate current dip.

An internal antenna changeover relay is included in the amplifier to feed the antenna through to the receiver when receiving or when the power is turned off. To eliminate any diode noise which might be generated by the final tubes during receiving, they are completely cut off by applying 120 volts to their cathodes during receive. Since the tubes used in the final heat up to operating temperature in about three seconds, it only takes this amount of time from the completely off condition to the full rated input. This permits the L-4 and its power supply to remain off until it is required for communications (such as rare DX!). The fan used to cool the final is amazingly quiet and it's nearly impossible to tell that it's on without looking.

The two meters used to indicate plate current, grid current, plate voltage and relative output are of the taut-band type for maximum reliability and long life. This type of meter movement has virtually no friction, so the operator is assured of accuracy and repeatability. The upper meter always indicates final plate current, while the lower one may be switched to read grid current,

plate voltage or relative output.

Tuning up the Drake L-4 is a real snap and only takes a couple of seconds. Since the input stages are broadbanded and present an essentially flat 50 ohm load to the exciter, if the exciter is properly loaded into a 50 ohm transmission line with low SWR, turning on the L-4 has no effect on exciter tuning. After waiting three seconds for filament warmup, you can hit the switch, load the antenna, tune for a dip and call CQ. By checking your plate current and plate voltage, your final dc input may be easily calculated from the chart that the Drake Company provides in the instruction manual. This chart takes into account any fluctuations in line voltage (and therefore plate voltage) so that the full legal limit under various conditions may be easily calculated.

Although the high voltage power supply may be operated from either a 115 or 230 volt line, the 230 volt system is recommended for best supply regulation. In fact, when the L-4 arrives from the factory, it is connected for 230 volt operation. For 115 volt operation, it is only necessary to move a couple of the jumpers on terminal strips in the power supply and rf power unit. However, if a 115 volt circuit is all that is available, it must be fused for 30 amperes, the circuit conductors should not be less than number 10 and no other equipment should be operated from the circuit. Do not operate the L-4 from a standard 115 volt light circuit because the circuit conductors are not large enough to safely carry this load.

Most homes are equipped with 230 volt service for either an electric stove or a clothes dryer, so it's a relatively easy matter to have an electrician run a 230 volt line into your shack. Another solution, and one that I have used is to make a 230 volt extension cord using three conductor, number 14 house wire. When 230 volts is required, all you have to do is unplug the clothes dryer and plug in your extension. This is not the most convenient method in the world, but it does work temporarily until you can get an electrician to put another line in. Be sure to use large 230 volt plugs and sockets on the extension cord so no one can plug a 115 volt appliance into this line.

The proof of the pudding of any amplifier of course is in the operating, and this is where the Drake L-4 really shines. In amateur operation, probably the toughest conditions are those when a rare dx station is on and dozens of fellows are calling him. Obviously, the strongest signals will consistently work the rare ones first. Another good test is over difficult paths; from the east coast for example, propagation into the south Pacific area is usually open less than an hour each evening. Assuming a good location and a good antenna, the station that can consistently work into Tahiti, Samoa and Fiji from New England has a power amplifier that is really putting out. The L-4 performed magnificently in a recent dx test and added several new ones to the W1DTY countries list, including several from the elusive south Pacific. Running phone patches is another test where the Drake L-4 comes away with flying colors. On 20 meters in the evening it is difficult to find many spots that are void of QRM. Therefore, to run a phone patch, even locally, you have to have an outstanding signal. Here again the Drake does a very nice job, providing strong readable signals where lower power and lesser amplifiers just wouldn't do the job. For the amateur who works dx or otherwise must work over difficult paths, the Drake L-4 linear amplifier may be just the answer. It certainly has done an outstanding job for me.

. . . W1DTY

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The Carrier Again

W7CSD's article, "Amplitude Modulation vs. the Carrier," in the October 73 generated a lot of mail. Here's some further discussion of the topic.

OK fellas, I get the message. If you're a school teacher this happens at least once a week. So you take another approach. Let's start over again in the reverse order. Let's start out with what we know we have and see if we can find out what we started with. A mathematical example will put everything in focus.

Let's assume we have a 100 watt carrier, 100% sine wave tone modulated working into a 100 ohm load. Now I know they don't make 100 ohm coax but this is a handy figure for us to work with. First, we all can agree that this signal consists of a carrier and two sidebands. In this case (most of us will agree anyway) we have a 100 watt carrier and two 25 watt sidebands. Since a scope looks at voltage, let's reduce this to power in terms of voltage and resistance or E²R = P. Solving for E we find

 See W7CSD's article on page 82 in the October 73.

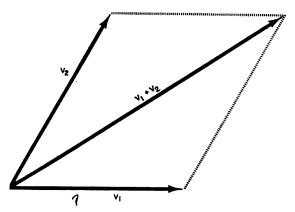


Fig. 1. Sum of two vectors. This is a parallelogram graphic solution.

that $E = \sqrt{RP}$. In the case of the carrier $E = \sqrt{100 \text{ x } 100}$ or $E_c = 100$ volts. Each sideband $E = \sqrt{25 \text{ x } 100}$ or $E_{sb} = 50$ volts. This will come as no surprise to most of us.

Now we know that we can represent any ac voltage as a vector (actually a rotating vector or more properly called a phasor). If we have several vectors to add we can add them up by several geometric means; the simplest is to form a parallel-ogram as shown in Fig. 1. The diagonal is the vector sum.

Now if all parts of the circuit are at the same frequency we can treat the vectors as though they were standing still and add them up and say this is what a meter will read if you put it in the circuit here. However if we are considering adding vectors at different frequencies we can only do so an instant at a time. In our AM signal (sine wave tone modulated) we have three components at three different frequencies. They must add up to the modulated wave. Let us use Ve, the carrier voltage, as a reference vector. Remember that it is rotating but we can treat it as if it were standing still if we use it as a reference. Then vectors of other voltages at other frequencies are rotating faster or slower than the reference. Now let's see what the vector sums are for several instants in time. At time T1 we find Ve in reference position, Vu, the upper sideband pointing to the left and rotating counterclockwise (by trigonometry counter clockwise is considered positive and the upper

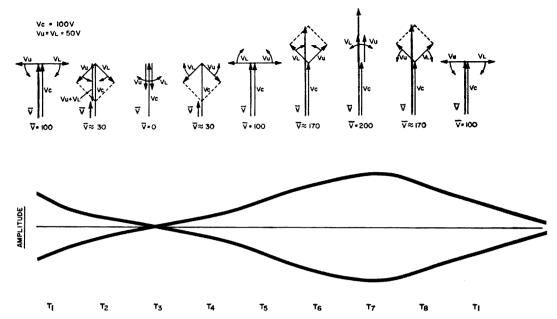


Fig. 2. Modulation envelope plotted from instantaneous amplitudes by vector addition. The color overprint gives the vector sum indicated by V with a short bar over it.

sideband is higher in frequency and therefore rotating faster than the carrier) and VL, the lower sideband is pointing to the right and rotating clockwise (slower than the carrier). The vector sum is the carrier itself or we are going thru the zero modulation point. 45° later at T₂ we see the resultant is a small fraction of the carrier and we are in the negative modulation area. At T₃ the sidebands completely cancel the carrier and we have 100% negative peak. At T₁ we have the same condition as T2. At T5 we have the same condition as at T₁. At T₆ the resultant is greater than the carrier and is in the positive modulation region. At T₇ all vectors add directly and we have twice the amplitude of the carrier.

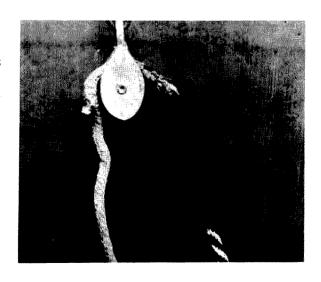
100% positive peak many other points in time could be taken. Thus we generate the well known AM envelope by vectorially adding the side bands and the carrier. Note, the carrier is there all the time. The question immediately arises. What happens if you over modulate? Now you cease to talk about two discrete sideband frequencies, upper and lower. You are now making a square-bottomed envelope and additional sidebands (splatter) are generated. What ever these additional sidebands may be they will make the vector sum of the carrier and all sidebands add up to zero on the negative peaks and the carrier will still be there.

. . . W7CSD

Replacing Halyards

Replacing halyards has always been a problem because a knot will not pass through the pulley hole. I have been using nylon ski rope which only costs several cents a foot and lasts for years. I found that when it had to be replaced I could cement the two pieces of rope together by using a small piece of Nylon twine between them. The small twine is inserted in the ends of the ropes and a match held underneath it until it becomes sticky. In a few minutes it will solidify and be secure. Now, by pulling on the old rope, the new one will come right on through the pulley.

. . . Ed Marriner W6BLZ



Jim Kyle K5JKX 1236 NE 44th Oklahoma City, Okla.

A Simple Current Controller

Frequently the experimenting ham finds need of a device to control *current* in a circuit, rather than voltage. One example of such a need is in a RTTY local loop, where current should be maintained at 60 mA (for a Model 15) even though line voltage, and as a result the dc supply voltage available for the loop, may vary. Another example is the bleeder resistor of a power supply, which must always draw a minimum current but which is only wasting power if more than that minimum is drawn.

The conventional approach to this situation is to use a voltage much higher than desired across the load, and drop it through a high-valued resistor. For instance, RTTY circuits often use a 125-volt supply and a 2000-ohm resistor, so that 60 mA can flow under short-circuit load. Small voltage changes then result in little current change.

In the case of the bleeder resistor, the resistor value is merely figured so as to draw minimum permissible current with the minimum voltage expected. As voltage rises, so does bleeder current, but we don't worry too much about the wasted power.

However, because of the unusual characteristics of tetrode, pentode, and beampower tubes, it's simple to build a true constant-current generator, or controller, which can be set for any desired amount of current and will maintain current flow

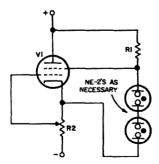


Fig. 1. A simple current controller.

very close to that value regardless of the voltage applied.

Some extra voltage is still needed to operate the tube, but it's usually much less than needed to assure reasonably-constant current under voltage variations, were the conventional resistor hookup employed.

The controller works because a tube with a screen grid will, if both screen and control grid voltages are fixed, maintain a constant current flow regardless of plate-to-cathode voltage (except at extremes of operating characteristics). Actually, the current isn't absolutely constant—but if, instead of holding control-grid voltage fixed, we obtain it by means of cathode bias so that the bias increases as plate current does, then the cathode current will remain virtually constant throughout the tube's operating range.

The circuit is shown in the schematic. No parts values are given because they will depend entirely on the individual application. The tube can be any screen-grid type which will pass the desired amount of current; in general, TV horizontal-output tubes seem to work best as their effective amplification is high. However, the 6V6 is also excellent.

The screen voltage should be chosen to allow the desired current to pass with the grid voltage placed about halfway between zero and cutoff. It should be regulated by a string of NE-2's or VR tubes as shown so that it won't vary with the current. R1 is simply a dropping resistor and should be chosen so that the NE-2's all light under operating conditions.

The value of R2 will determine the range of current control possible. Its maximum setting should be such that cutoff voltage for V1 will be developed by the minimum current desired. Then with the arm toward V1's cathode, current will increase, and with maximum resistance in the circuit, current will be at a minimum.

To see just how this works, let's plug in a few numbers. Let's assume we're using a 6V6 for VI, and are holding its screen voltage at 250 volts. Furthermore, we want to have 20 mA current flowing in the external circuit.

A look at the curves for the 6V6 shows that with a screen voltage of 250 volts, and the same voltage on the plate, a grid-to-cathode bias of 20 volts will allow 20 mA of current to flow. This 20 mA will develop the required 20 volts across a 1000-ohm cathode resistor, so we use a 1000-

ohm unit for R2 and bring the grid back to the lower end (with a larger pot, we set it for 1000 ohms between grid and cathode).

Now if the load should attempt to make current increase to say 25 mA, the grid bias voltage would also increase to 25, reducing current flow to about 9 mA. Of course, as the current flow dropped the grid bias would drop accordingly, so that as current passed 20 ma going down the grid bias would be back at our 20-volt starting point and the practical effect would be that the current never got a chance to change at all.

If the voltage applied to the current-control and load together were to increase so that there were 400 volts across the 6V6 instead of 250, the 20-volt bias would still hold current to 21 mA. However, 21 mA of current would increase bias to 21 volts, which would result in current dropping to about 18 mA, and as before it would stop before dropping so low. The stop this time wouldn't be right at 20 mA, but would occur at approximately 20.05 mA—which is fairly close control!

Should we want to deliberately increase the current from 20 to say 40 mA, the curves tell us that grid bias should be 13½ volts. Ohm's Law tells us that about 338 ohms is the size resistor needed to develop 13½ volts with 40 mA flowing, so that's the setting for R2.

Now an increase in load current from 40 to 60 mA would give us a bias increase to 20¼ volts, which would in turn reduce current to about 20 mA, and on the way down things would lock up at 40 mA where they started, just as before.

Thus, by making R2 adjustable, we can dial the amount of current we want to flow in the circuit, and the controller keeps that current constant.

Should supply voltage drop so low that the screen voltage of VI drops out of regulation, the gadget fails. This can be overcome by supplying the screen from a separate source, because plate voltage can be allowed to drop far below the screen value before the device stops working. However, in many applications the major problem is a change in current drawn by the load,

Used as a bleeder resistor, this circuit will draw only the amount of current it is designed to pull no matter how high the supply voltage goes (until VI blows up from overvoltage around 1500 volts or so!).

Second-hand 6L6's are cheaper than 25-watt resistors, and far cheaper than 100-watt bleeders. The wattage requirement in a bleeder comes primarily from the power thrown away by excess current at highest voltage; this hookup will let a single 6L6 bleed a 750-volt supply, without wasting any current either.

. . . K5JKX

What's New for You?

This second of our monthly columns devoted to any topics of special interest to the technically-minded ham will be a bit short as the first announcement of the column didn't reach readers in time for them to submit items. We'll be looking for something from you in next month's 73.

This column is interested in short notes about new semiconductors, newly available surplus, technical nets, technical meetings, new records, comments about articles that have appeared in 73, notes about equipment and other topics. Please make your comments short and get them in to us early. The deadline for items for the next possible issue of 73 (April) is the 10th of February.

Paul Franson WA1CCH

Correction

The "Home Brew Rectifier" described on

page 52 of the November issue is wired for a negative output voltage rather than positive. If you wish to use this circuit for B+, reverse the diodes.

Attention Galaxy Owners

Owners of Galaxy 2000 Linears and Galaxy remote VFO's should write for service bulletin 6-1, which gives some useful information including the use of the remote VFO on RTTY. Write Owen L. Meyerson, Galaxy Electronics, 10 South 34th Street, Council Bluffs, Iowa 51504.

Correction

In the article by WIOOP in the September 73, "Add AGC to your receiver," the diodes in Fig. 2 on page 27 are reversed.

Correction to Correction

Sigh. The correction on page 113 in the December issue is wrong. The N-channel and P-channel FET's are reversed.

Equalizing AFSK Tones

Common methods of keying audio oscillators for AFSK lead to unequal mark and space amplitudes. This article describes a simple method to avoid this.

The common method of obtaining an audio frequency shift signal is to switch the tuning capacitance of an audio L-C oscillator, as shown in Fig. 1. The space frequency (2975 Hz) is formed by L-C1, while the lower mark frequency (2125 Hz) is formed by L-(C1+C2). While adding C2 lowers the frequency, it unfortunately lowers the circuit impedance which usually lowers the Mark output level. I say "usually", because it depends on the oscillator circuit and the circuit Q. This reduced mark output can cause distortion in the receiver TU, and lowers the mark S/N ratio.

A review of the literature shows that this mark-space amplitude difference is either neglected or equalized by a C or LC network in the oscillator output. I would like to propose a much simpler method of tone equalization.

The Twin City AFSK circuit was used as a typical oscillator for tests, with the keying circuit temporarily omitted (Fig. 2). The mark amplitude was measured at 3 dB below the space amplitude. Let's see what

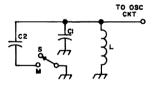


Fig. 1. The common method of obtaining an audio frequency shift for RTTY.

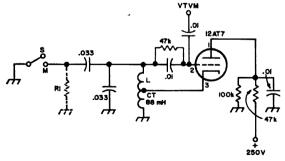


Fig. 2. Oscillator section of Twin City AFSK less keying diodes.

can be done about this.

Instead of thinking of the mark amplitude as being too low, let's consider the space amplitude to be too high, and look for an easy way to lower it. Adding resistor R₁ (Fig. 2) across the switch does the trick. The mark circuit (L-C₁C₂) is not affected, but the Space circuit now has its Q lowered by R₁ in series with C₂. As the value of R₁ is decreased from a very high value the space amplitude drops quickly, but the space frequency is almost unaffected, as shown in Fig. 3. For this particular circuit the tone amplitudes will be equal if R₁ is 125kΩ. The space frequency shift due to R₁C₂ is only 3½ Hz.

Now let's continue with the diode keying circuit of the Twin City circuit, Fig. 4. R. loads the space circuit through the keying diodes, D₁ and D₂. The circuit characteristics were first measured using silicon TV diodes

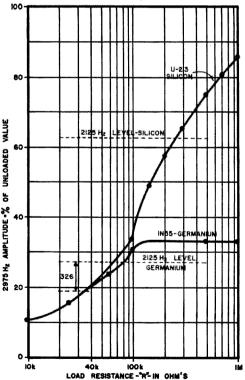


Fig. 3. Effect of tuned circuit loading an amplitude.

(Texas Instruments U-213) for D_1 and D_2 , with the results shown in Fig. 5. Note that the mark and space tones will be equal in amplitude if R_1 is $250k\Omega$.

Next germanium 1N35 diodes were tried. These are similar to the Twin City 1N54's, which I didn't have. Fig. 5 shows that the germanium diodes load the space circuit, due to their low back resistance. R_1 should be about $85k\Omega$ for equalization, but this will vary with the particular diodes used. (The voltage across the oscillator circuit is a bit high for 1N54's and 1N35's). If R_1 is $39k\Omega$ as shown in the Twin City circuit, the space amplitude will be about 3 dB below the mark, just the opposite of the usual situation.

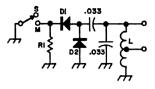


Fig. 4. Twin city keying circuit.

While the proper value of R₁ will vary with the circuit used, I believe an equalizing value can be found for almost any oscillator and keying circuit. Remember that equal mark-space percentages of modulation are the goal. If your speech amplifier is not flat, this system will permit the proper amplitude adjustments.

. . . K8ERV

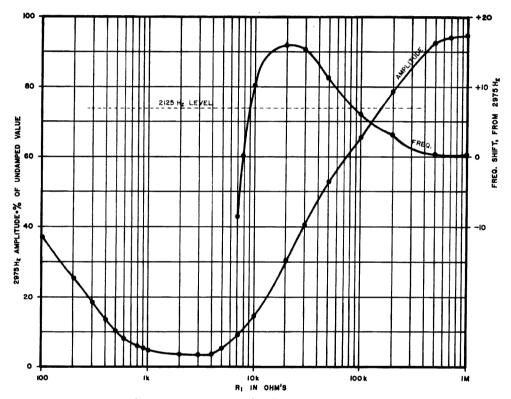


Fig. 5. Effects of diode loading on space amplitude.

Cutting Holes in Window Screens

When you bring a transmission line into the shack, many times the most obvious route goes right through a window screen. Much to the consternation of the XYL, many hams are apt to stick a screw driver into the screen and spread the strands a little bit. A neater method is to use a conventional chassis punch about a half inch in diameter. To prevent the strands from unraveling, several techniques may be used.

If the screen is brass or copper, the strands around the opening may be soldered together. For aluminum or plastic screens, a little bathtub caulk does a marvelous job. If care is taken in choosing the size of the chassis punch, the cable will fit snugly in the opening and no insects will get in. Furthermore, if the hole is placed near one of the corners, it may be patched up later with little notice. . . . Jim Fisk W1DTY

International Crystal SBX-9 Sideband Exciter

If you're one of those fellows who has been procrastinating about getting on VHF sideband, the new International Crystal 9 MHz sideband exciter is just what you're looking for. The high frequency addicts can read on too, because the SBX-9 is equally suitable for any of the ham bands below 30 MHz. Basically, this new exciter from International Crystal is a crystal controlled 9 MHz single sideband generator with selectable upper or lower sideband. It uses a very steep sided four crystal half lattice filter in conjunction with a 7360 balanced mixer to obtain a minimum of 45 dB carrer suppression with at least 40 dB suppression of the unwanted sideband.

In all, the SBX-9 uses four tubes to generate 0.5 volts of 9 MHz sideband energy across the 50 ohm load. In the input a high impedance dynamic or ceramic microphone is used to drive a 12AX7 audio amplifier; this audio signal is fed into one side of a 7360 balanced modulator. The control grid of the balanced modulator tube is fed by

SBX-9 Specifications

Frequency: 9 MHz crystal controlled.

Operating Selectable upper or lower

mode: single sideband.

RF output: 0.5 volts across 50 ohms.

Sideband Four crystal half lattice filgeneration: ter. Carrier suppression 45 dB minimum, Unwanted

dB minimum. Unwanted sideband suppression 40 dB

minimum.

Audio input: High impedance dynamic

or ceramic microphone.

Tube lineup: 6BH6 oscillator, 12AX7 au-

dio amplifier, 7360 balanced modulator, 6BA6 rf ampli-

fler.

Features: Push to talk relay; front

panel control of balanced modulator; full metering of rf output for balance ad-

justments.

Size and 8%"x5%"x9%". 12 pounds. weight:

Power re- 115 volts ac, 50/60 Hz, 36 quirements: watts.

-

Price: \$125.00

the 9 MHz rf carrier which is generated by a 6BH6 crystal oscillator stage. The carrier is balanced out in the 7360 by the balance control which is connected to the tube's beam deflection plates. When the audio signal reaches the 7360, the balanced modulator becomes unbalanced at an audio rate and produces a double sideband suppressed carrier signal. This signal is fed into a crystal filter where the undesired sideband is suppressed and the desired sideband passes through to the grid of the 6BA6 rf amplifier. The desired sideband is selected by choosing the exact frequency of the 6BH6 crystal oscillator. Since the 2 kHz crystal filter is centered on 9000.00 kHz (9 MHz), the upper sideband will pass through the filter when a 8998.5 kHz crystal in used in the oscillator; conversely, the lower sideband will get through if a 9001.5 crystal is used. Because of the steep sides and narrow passband of the crystal lattic filter, the audio sideband outside the filter passband is suppressed some 50 dB. The 6BA6 rf amplifier is tuned to MHz and feeds the 50 ohm output through a link coupled to the plate tank.

There is a test switch provided on the front panel of the exciter which unbalances the balanced modulator and keys the push to talk relay. This is used where a carrier is necessary for adjustment of an external power amplifier or mixer. The internal push to talk relay has a number of contacts which are brought out to the accessory socket. These auxiliary contacts may be used for turning on external power amplifiers, switching antenna changeover relays and muting receivers and converters.

Since the SBX-9 has a fixed 9 MHz output, the front panel has a minimum number of controls. In fact, to put it on the air all you have to adjust are the carrier balance and audio gain controls. And, once the carrier balance is set, it requires very little further attention. A 100 microampere meter is connected across the plate circuit of the 6BA6 rf amplifier to measure the amount of carrier. All the operator has to do is

International Crystal SBA-50 50 MHz SSB Mixer-Linear Amplifier

turn the SBX-9 on, key the push to talk relay and adjust the balance control for minimum indication on the meter; then talk into the mike and adjust for proper audio gain as indicated on the meter. The complete adjustment takes only a couple of seconds and results in a minimum of 45 dB carrier sup-

The SBX-9 is designed primarily as an exciter for the SBX-50 50 MHz mixer-amplifier, but it may be used with homebrew mixers on other amateur bands by the proper selection of frequencies. The use of a 5 MHz VFO and suitable mixer-amplifier circuits for instance would provide single sideband on either 75 or 20 meter phone. Other frequencies may be added by the addition of appropriate crystal controlled mixer

The sideband signal from the SBX-9 is very clean on the scope and sounds very crisp and sharp. The high quality crystal filter and use of double tuned circuits results in high efficiency with maximum suppression of undesired signals. For the amateur who is interested in getting on sideband without going to a transceiver, particularly on the VHF bands, the International Crystal SBX-9 is an ideal choice.

The new International Crystal SBA-50 50 MHz single sideband mixer-linear amplifier was designed as a companion unit for the SBX-9 sideband exciter for operation on six meters. This dandy little transmitter takes the 9 MHz sideband output of the SBX-9, mixes it with a crystal controlled signal in the 41-45 MHz range and puts out 10 watts of single sideband single tone on six meters.

The circuitry of the SBA-50 is quite straightforward, starting out with the triode half of a 6U8 in a simple third overtone crystal oscillator circuit to provide the necessary output on 41 to 45 MHz. If VFO operation is designed, it may be connected to the SBA-50 through the accessory socket on the rear deck of the unit. However, one of the three crystal positions must be va-

cated and that switch position used when the transmitter is VFO controlled. The tetrode half of the 6U8 is operated as a VHF mixer. In this section of the 6U8 the 41 to 45 MHz signals from the crystal oscillator are heterodyned with the 9 MHz signal from the single sideband exciter. The resultant sum frequency at 50 to 54 MHz is selected by the tuned mixer plate circuit and inductively coupled to the grid circuit of the 12BY7 linear buffer amplifier. This six meter signal is further amplified by the 6360 linear power amplifier and link coupled from the power amplifier tank circuit to the 50 ohm coaxial output. This signal may be used for communications within the six meter band or used to drive a larger linear power amplifier.

SBA-50 Specifications

Frequency	
COVERSES	٠

50-54 MHz. Three crystal conrolled channels selectable from the front panel

or external 41-45 MHz VFO may be used.

RF output:

10 watts single sideband single tone.

RF drive required: 9 MHz single sideband, 0.5 volts across 50 ohms.

Output impedance: 50 ohms nominal.

Tube lineup:

6U8 crystal oscillator/VHF mixer, 12BY7 linear buffer amplifier, 6360 linear power amplifier plus two 0B2 volt-

age regulators.

Crystals required:

3rd overtone type in the 41-45 MHz range; three crystals furnished with 41-45

unit.

Features:

Crystal or VFO control; provision for external push to talk control; complete metering of 9 MHz drive, oscillator grid, buffer grid, power amplifier grid and rf

output.

Power requirements 115 volts ac, 50/60 Hz, 37

watts.

Size and weight: 8¾" x 5%" x 9-9/16". 13

pounds.

Price:

\$145.00

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We should give fair warning to those who order this new book from the Radio Society of Great Britain. Once you pick it up, you won't be able to eat, sleep, talk or watch TV until you've read it all. It's a fascinating, densely-packed, 100-page book full of every imaginable practical circuit for ham radio. Hundreds of circuits and ideas are discussed, and each one is useful to hams. Here are the chapters: semiconductors, components and construction, receiver topics, oscillators, transmitter topics, audio and modulation, power supplies, aerials and electrical interference, troubleshooting and test equipment. Once you've digested this book thoroughly, you won't be able to build or modify any gear without consulting it.

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The SBA-50 is very easy to use and it only takes a few moments to completely tune it up. Once the SBX-9 9 MHz exciter has been properly tuned up, it is a simple matter to tune up the SBA-50. The switchable meter circuit may be used to read any one of five different circuits within the amplifier; the oscillator grid, 9 MHz drive (mixer grid), buffer grid, power amplifier grid, and rf output. Except for the input and output circuits to the final power amplifier stage, all the circuits have been factroy adjusted so there is a minimum number of panel controls to worry about. Since most six meter operation is limited to 52 MHz and below, the circuits within the transmitter are broadbanded enough to require no further tuning. However, if operation from one end of the band to the other is required, it may necessitate tweaking up the circuits slightly when going from 50 to 54 MHz.

Adjustment of the final amplifier tuning controls is very straightforward; put the SBX-9 exciter in the test position, place the meter switch in the PA grid position and adjust the grid tuning control for maximum reading; then place the meter switch in the rf output position and adjust the plate tuning and loading controls for maximum rf power out. Once the audio gain control has been adjusted for the proper meter reading, you're ready for your first six meter single sideband QSO.

You won't find a great deal of six meter single sideband activity in some parts of the country, but with units like the SBX-9 and SBA-50, it shouldn't be too long before all the stations on 6 meters are using this more efficient mode found on the lower frequencies.

These two new units are ideally suited for the amateur who is interested in sideband communications on our VHF bands. Although this complete unit is designed for six meters, the resultant six meter signal may be heterodyned up to two meters, 220 or even 432 with a simple homebrew mixer circuit. These units are extremely well made, stable and put out a very clean and crisp signal. With the supports on the upswing, it won't be too long before there will be world wide openings on six meters. When the DX going gets rough, it has been proven that ssb is the mode to be using; the SBX-9 and SBA-50 provide an excellent base for an outstanding ssb signal on six meters.

...WIDTY



The National 200

Jim Fisk WIDTY RFD 1, Box 138 Rindge, N. H. 03461

When National came out with their new model 200 transceiver a few months ago at a lower cost than any other five band transceiver on the market, I just couldn't believe that it would perform as well as the more expensive models. But-after using it for several weeks in chasing DX, I find that they have done a superb job and performs right along with the best of them. The sensitivity is fine, the selectivity afforded by the steep-sided crystal filter is excellent, and the audio reports, if I am to believe the fellows on the other end, have all been good. Reports of, "tremendous audio quality," "really sounds good," and "very clean and crisp," have been normal reports during the time I have had the 200 on the air.

In the National 200 the final amplifier pi network and the driver tuning circuits also double as the rf circuits for the receiver. The VFO and carrier oscillator are common to both transmitter and receiver and the first if stage in the receiver also serves as a low level amplifier in the transmitter. The use of common crystal filter and rf input components results in a sensitive and relatively image-free receiver and highly efficient ssb transmitter. Sideband switching is automatic with lower sideband on 40 and 80, and upper sideband on 20, 15 and 10 meters.

The front end of the receiver starts out with a 6BZ6 rf amplifier, followed by a 12BE6 mixer, the 5.2 MHz crystal filter, two 12BA6 if stages at 5.2 MHz, a 12AX7 AM detector, product detector and first audio, and finally, a 6AQ5 audio power stage. The AGC voltage is derived from the second if stage, run through a semiconductor diode voltage doubler to get it up to the proper level, and then applied to the

first if and rf stages.

The 8.7 to 9.3 MHz high frequency mixing signal from the VFO is premixed in a 6GH8 stage with a crystal controlled signal on 40, 15 and 10 meters so only one stage of conversion is required in the receiver itself. On 80 and 20, the VFO signal is mixed directly with the incoming rf signal to obtain the 5.2 MHz if. This procedure somewhat simplifies things and eliminates many problems with spurious responses and birdies that might appear in the receiver tuning ranges.

The tube lineup in the transmitter begins with a 6GH8 microphone preamp, then

to a 6GH8 speech amplifier and solid state balanced modulator where it is mixed with the 5.203 MHz signal from the 12BA6 carrier oscillator. The sidebands at the output of the balanced modulator are fed into a 12BA6 transmitting if amplifier and then into the crystal lattice filter. The sideband output of the filter goes through another 12BA6 for further amplification, then to a 6JD6 transmitting mixer where it is mixed with the VFO and carrier oscillator signal available from the 6GH8 premixer. A 6GK6 driver and two 6JB6's in the final complete the layout of the 200 watt ssb transmitter. The excellent sideband qualities are a direct result of the very steep sided crystal lattice filter and the use of double tuned circuits in the transmitting if stages.

The National 200 incorporates a very sensitive automatic level control (ALC) circuit in the final. This circuit makes use of the fact that when the control grids of the power amplifier tubes are overdriven on voice peaks, the resultant positive voltage on the grid causes grid current to flow. This current in turn causes a negative voltage change in the bias network; the resulting audio signal on the bias circuit is capacitively coupled to a voltage doubler for rectification and fed back to the first if stage to control the audio gain. When the final amplifier is overdriven, the gain of the first if stage is reduced, resulting in less driving signal at the fnal. The ALC voltage cannot discharge through the voltage doubling circuit, so the resultant action is a fast attack and slow release. The circuit is designed to provide an automatic leveling control for 10-dB variations in the audio signal. This makes the setting of the microphone gain quite noncritical and changes in the voice level or large background noises are controlled without distortion. When the National 200 is used with a linear amplifier, there is provision for using an external ALC signal from the linear to control the audio stages of the 200.

The variable frequency oscillator used in the National 200 uses a straightforward grounded-cathode Hartley oscillator. minimize the effects of warmup drift and to insure long term frequency stability, all the frequency determining components in the VFO have been carefully selected. To further insure the frequency stability of the unit, the output is taken from the screen grid of the oscillator tube. After a 30minute warmup, the stability seems to be very good. Variations in line voltage have

National 200 Specifications

Frequency Coverage:

3.5-4.1 MHz. 7.0-7.5 MHz, 13.9-14.5 MHz, 21.0-21.6 MHz, 28.5-29.1 MHz with crystals provided.

Types of Emission:

SSB (upper sideband on 20, 15 and 10 meters; lower sideband on 80 and 40 meters), AM, CW.

Power Input:

200 watts PEP SSB, 200 watts CW, 100 watts AM.

Power Output 120 watts PEP SSB, 120 (Nominal): watts CW, 30 watts AM.

SSR Generation:

Crystal lattice filter: dB shape factor 2.2:1. Bandwidth 2.8 kHz at 6 dB. Carrier suppression -50 dB; unwanted sideband suppression -40 dB; 3rd order distortion products sup-pressed -30 dB at full out-

Receiver Sensitivity:

0.5 μV for 10 dB S/N in SSB mode.

Features:

Full AGC and S-meter on receive, push to talk or manual operation on transmit with ALC for ssb. Automatic carrier insertion for AM or CW. Product detector for SSB and CW, AM detector for AM on receive. Grid block keying on CW.

Tuning dial:

45:1 tuning ratio, Dial calibrated at 5 kHz points on

all bands.

Tubes and semiconductors: 16 tubes, 10 semiconductors, parallel 6JB6's in the pow-

er amplifier.

Accessories:

AC-200 power supply for either 117 or 234 Vac, 50/60 Hz; XCU-27 100 kHz crys-

tal calibrator.

Size and weight:

6-3/16" x 13%" x 11". 15 pounds.

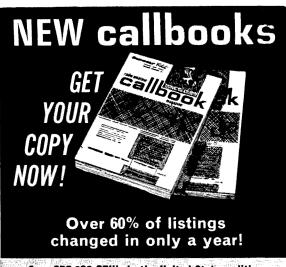
Power requirements:

700 volts dc at 300 mA, 280 volts dc at 200 mA, -80 volts dc at 10 mA, 12.6

volts at 5 A.

Price:

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only a very slight effect; not enough to require retuning the station you're working. After an initial 5 minute warmup, the unit drifted about 1000 Hz over the next 25 minutes; after this 30 minute period the drift was insignificant.

In addition to operation on single sideband, the 200 may be used on CW or even AM. A simple adjustment on the back sets the carrier insertion for CW and AM. Once this control has been set for one band, it may be left alone. The mode switch on the front panel automatically suppresses this control for ssb operation but permits full carrier insertion on AM and CW. Actually, when this pot is switched into the circuit in the AM and CW modes, it is used to upset the balance of the diode modulator. In addition, for AM or CW, the bias is removed from the 12BA6 transmitting if stage, providing full carrier insertion of 60 to 300 mA.

This transceiver is designed to load into a 40 to 60 ohm unbalanced load. When the load is within these limits, it loads up very nicely and quite quickly with the three controls required. In this respect, the National 200 is similar to many other transceivers on the market—peak the exciter, load the power amplifier and tune for a dip. Since the receiver uses the transmitter tuned circuits in its input, when the transmitter is tuned up, the receiver is also matched to the transmission line. In the transmit mode, the meter reads final amplifier cathode current; in the receive mode it functions as an S-meter.

The National 200 may be used either in a fixed station from the 115 volt line with the AC-200 power supply, or mobile with a power supply that furnishes all the necessary voltages. To aid the mobileers, National has thoughtfully included a mobile mount in the package with the 200. This mount is a U-shaped bracket that may be clamped under the dash of your car; the transceiver fits into the bracket and is held in place with a couple of large knurled thumb nuts. To remove the unit for fixed station operation, all you have to do is disconnect the antenna and power plug and remove the thumb nuts.

All in all, the National 200 transceiver seems like a very good investment for those of you who are shopping around for a good all band transceiver. It is compact, lightweight, easy to use, and best of all, it works well. It's not often that you get all these attributes in one package!

. . . W1DTY

A Universal Code Monitor

Want a monitor that requires no external battery, can be used with each and every cathode-keyed transmitter, and is small enough to be mounted to your key?

By taking advantage of the voltage drop across silicon diodes in the forward biased condition, a convenient source of regulated voltage to power a transistorized code monitor is attained.

Referring to Fig. 1, the heart of the universal code monitor is shown. Placing three silicon diodes in the ground lead to the transmitter from the key accomplishes two objectives: One, with the key open, any possibility of high voltage being present across the transistor is eliminated; and two, with the key closed, a voltage drop of approximately 2.1 volts is obtained for powering the monitor. (0.7 volts per silicon diode in the forward biased condition) Watch the polarity of those diodes! If they are placed in the wrong direction, it will be readily apparent as no current will flow.

Three diodes have been shown, but the actual number will vary depending upon the overall volume level required. More diodes-more voltage, and hence louder the volume produced. With 2.1 volts to power either of the two transistor circuits shown, the volume is sufficient for the average ham shack. Selection of the diodes will depend upon the current drawn by the keyed stages of your transmitter. To make it universal, 500 mA diodes should be used. The monitor may then be used with any transmitter drawing from 10 to 300 mA. In this application, the PIV rating of the diodes is not important, so relatively inexpensive diodes may be used.

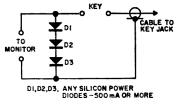


Fig. 1. The voltage drop across three forward biased silicon diodes is about 2.1 V, sufficient for simple oscillators as shown in Figs. 2 and 3. The diodes are shown for a cathode keyed transmitter.

Fig. 2 shows a transistorized circuit which may be used. This circuit draws approximately 2.5 mA at the 2.1 volt level and gives sufficient volume even under noisy conditions in the ham shack. If an output transformer other than that specified is used, some juggling of C₁ and C₂ may be necessary to obtain oscillations.

Got a portable radio around that is no longer used? If so, the parts to build an audio oscillator may be laying there waiting to be used.

Fig. 3 shows an oscillator circuit which may be easily built from parts normally encountered in the small portable radio. The driver transformer may have four leads on the secondary. If it does, simply solder the two middle ones together for the center tap. Use caution in removing the transformer from the portable radio's printed circuit board as excessive heat can open the leads internally.

The speaker can be the one in the portable, or may be one with an impedance anywhere from 3.2 ohms to 100 ohms. The transistor can be the preamp, driver, or one of the output transistors in the audio stages of the portable.

This oscillator does not give the volume that the one in Fig. 2 does, but is sufficient in a quiet ham shack. Of course, more diodes at the key would produce higher voltage and higher output. With the values shown, this oscillator draws only microamps at 2.1 volts. If lower values of base bias resistors are used, the current drain will go up correspondingly. Changing the values of the capacitors across the transformer will change the tone, but with the values shown,

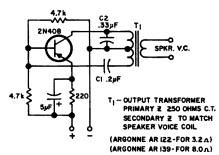


Fig. 2. A simple, loud monitor. It draws about 2.5 ma at 2.1 V.

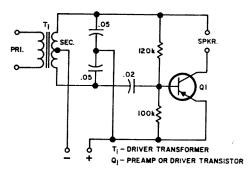


Fig. 3. This monitor can be made from parts from a junked transistor radio.

a pleasing tone is readily attained with most driver transformers. The capacitors shown are generally present in the radio.

Due to the relatively small number of components and their small physical size, the whole monitor may be built directly on the key through suitable means. Changing from one transmitter to another presents no problems as that encountered with monitors which require a pickup loop or external power source. Simply plug your key into the next transmitter.

If you want some additional code practice, just connect a 11/2 volt battery to the monitor and you're on your way.

... K9VXL, K9CLH

(Editor's Ramblings from page 4)

issue, we've been printed by Hildreth Press of Bristol, Connecticut, a division of the Printing Corporation of American. We've endured bad service, indifference, poor quality and improperly-wrapped and late magazines. We have been shooting for a mailing date of the 13th of the month preceding the date on the cover, but haven't hit anywhere near it. For instance, the December issue was mailed in early December instead of November 14. Attempts to improve the situation have been fairly fruitless, and we decided that the only solution was to change printers.

Our new printer is Morton Printing Company in Pontiac, Illinois a central location that should please hams on the West Coast. We're hoping that they will be far more satisfactory in a number of ways, and expect the 73's to be mailed on time. Of course, I have no way of knowing as I write this editorial (on December 14) whether the magazines were mailed on time. Changing printers is rough at best, and lack of cooperation from the printer you're leaving can hold things up quite a bit.

. . . Paul

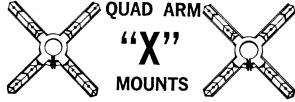
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Gus; Part 20

In the last episode I was back at Aldabra Island for the second time, but business was not as brisk as before since I had over 7,800 QSOs the first time there a few months before. There must be a new crop of DXERS every few years because I QSO many fellows right now who tell me they still need Aldabra. The second stay there I had something like 3,500 QSO the few days I was there, most of them saying, "Thanks for the new one!" I guess most of these boys must have been on the second and third lavers the first time there. I wonder how many were on the fourth and fifth layers? I guess every three or four years any place becomes rare if there is no activity from it during that time. So many fellows keep saying they need this or that even after thousands of QSOs and at times right after I had left a place too.

This second trip to Aldabra was for the purpose of bringing supplies, loading up copra and hauling back "live turtles" Mahe. This was a pretty fair size ship this trip. After loading up dried fish, copra, exchanging a few island workers we were ready to finish loading up the boat from stem to stern with those big turtles, live ones at that. They were loaded on the ship by a small crane and placed upon the deck upside down and covered with wet coconut and palm branches. These branches were to be kept wet all the way back to the Seychelles to keep the turtles from drying out. It was quite a mess trying to walk around the deck with all these turtles everywhere. Usually you ended up on tip-toeing between them, but at times you had to walk smack on top of them. This did no damage to them since they were tough old critters and it

took a lot more than walking on them to kill them. Anchors were lifted and we were again on our way to VQ9 land. The mood of the sea was not very good, because the South East monsoon was in full swing and the date indicated we were in about the middle of the monsoon. You just connot expect a nice smooth sea at this time of the year in that portion of the Indian Ocean. The weather was like it was supposed to be-rough seas. My /MM operating position was up on the "Poop Deck" right beside the big wheel, and strapped down good and solid. We were about 25 or 30 foot above the water and this more or less multiplied the tossing of the ship. The chair was fastened down good and solid too, or I would have slid all over that little room. Radio conditions were excellent. They always seem to be when you are at sea. I still think the world's best operating place is in the middle of the ocean with that beautiful ground all around you. I think its even better than the QTH of W5VA and W3CRA. I bet if a fellow had a full kW and a five element beam on a ship out in the middle of the ocean "no one" would trample on him. He would always be on the top of the pile. After being out from Aldabra only 2 days I was up in the little poop deck operating away about 5AM and out the corner of my eye watching the young fellow at the wheel who in turn were watching the big compass keeping the ship on course many sea birds were all around the ship, a few porpuses were parading pass the ship taking their morning's tour I suppose, and even a few schools of flying fish were seen taking off when the ship caused them ORM. Plenty of activity is always seen at that early hour when at sea, we were getting our second cup of that strong coffee from the galley boy and we were just taking it easy as no big pile was on hand on the bands. I was just enjoying myself and I think the fellow at the wheel was doing the same. We two and one fellow in the engine room, I think was all that were up out of the sack, everyone else was sound asleep waiting for the six bell signal for them to get up. I then noticed the fellow at the wheel was doing a little straining at the wheel which was very unusual because generally he could could turn the wheel with two fingers and never any strain whatsoever. About five minutes later I noticed he was really trying to pull the wheel with both hands and it was not moving at all. I pulled off the phones and asked him what was wrong? He

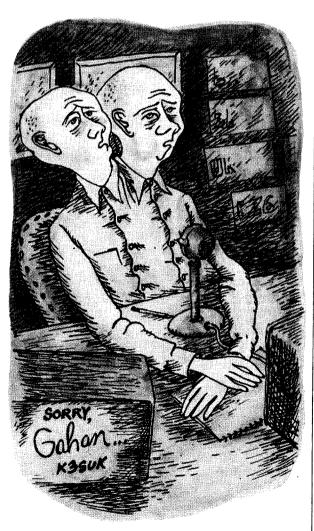
said there was some trouble with the wheel or rudder. After he had pushed and pulled on the wheel a few minutes it suddenly started "free wheeling" and thats when he said. "we have some bad trouble somewhere". Down he went to wake up the captain and the ship turned broadside to the wind, the engines were turned off and all sails let down. Seems like everyone on the ship suddenly woke up when the ship turned broadside to the wind and began to really toss and pitch. The captain and all the rest of us went to the rear of the ship to look at the rudder, there it was turned up at about a 45 degree angle and right when we all were looking, it dropped off the ship and sank to the bottom of the Indian Ocean. We were at least 200 miles from the nearest island and a lot's further than that from Mahe, drifting with the wind and currents. The gang was worried to say the least. We just drifted a few hours while the situation was discussed, the captain did not seem to disturbed about the situation as much as the ship's crew. They were concerned. As for myself I took the attitude that it was not my ship and if it sank it was no money out of my pocket. The radio gear was insured, so Ack said, so nothing to worry about there, and I had a good life insurance policy so I figured the one to really worry was my insurance company not me! I decided since I had no intention of diving overboard to try to find the rudder that I would just head back to the poop-deck and do a little hamming and get my mind off the situation. The little putt-putt was again cranked up and a CQ sent, I had quite a few good ragchews with the boys and did mention to some of them about our rudder being missing, Some said, "That tough Gus". Others said "Sure hope you all find it." (Who was going to dive to the bottom of that Indian Ocean?-NOT ME!), Some W5 said, "Well I'll be doggoned if that ain't tuff, Ole Buddy" Someone asked me over the air what was I going to do, and I said "nothing". Had a FB OSO with some EP2 station in Tehrein and told him the whole story, he said he was going to do what he could for us! He was very interested in the whole story, our exact QTH and all other details about the whole thing. The captain wanted me to try to get in touch with Harvey Brain-VQ9HB in Mahe so he could get a message to the ships owner-Mr. Teemoulgee, the big merchant in the Seychelles. I told him I would have to get the message to Harvey thru (5Z4GT Leny or George 5Z4AQ) that even-

ing. That evening about 6 PM local time I did get a OSO with George 5Z4AO, and he said "My God" when I told him of our troubles without a rudder, broadside the high winds, water slashing over all the decks and everyone starting to worry-except the Captain and me. I am one of these fellows who thinks when his number is up, it's up, Or else I am crazy enough to just not worry about something that was out of my control, and something I could not do anything about. I gave George all the details, our QTH, directions of the winds, number of people on board, etc. I found out later that since George was working for Kenya Radio that all this info was put out thru the Cable and Wireless and broadcast world-wide for all the news services to pick up. It was picked up in Orangeburg, South Carolina and broadcast probably by all three of the broadcasting stations here. My wife heard this broadcast and this started the ball rolling, all the children was called home, our local Baptist minster was called to our house, lots of weeping and carrying on around the Browning house. Someone suggested contacting Ack, this was done and Ack assured them that we were not in any immediate trouble (I like that word immediate!). So they quit worrying (I think) and things calmed down at home. Things did not calm down on the ship, oh not by a long ways. Everyone was discussing our troubles and making suggestions. The captain had his own opinion as to what he was going to do. He had decided to use a cabin door to replace the rudder. The largest cabin door was removed and large rope attached to it, no hinging was possible, it was going to have to be controlled by pulling ropes. A big "V" groove was sawed in the rear portion of the boat, this was where the Cabin door was supposed to fit in so it could be swung back and forth. Now you picture trying to mount this thing on the rear of the ship and remember those large waves and high winds trying to keep you from doing this. Now Buddy I could see that we had problems and I mean big ones. This cabin door was supposed to be held in place by those 34 inch ropes being tightened by pulling in from both sides to hold it in the "V" center of the groove. Everybody grabbed their ropes and they edged the cabin door towards that "V" groove, bang, a big wave hit it, it went sailing off across the water, back it was pulled by the ropes. The men were excited, and a number of them were almost pulled overboard.

sneaked down into that little "V" groove again, it gets pretty close this time, and away it goes again, a few little cuss words here and there, a little hair pulling, more discussions and try again, this kept up hour after hour. The Captain showing no signs of discouragement. Everyone else agreed that this task was absolutely impossible and asked me to get a message to Mombassa for a towing ship to be summoned so we could get back to Mahe! We took a position "shot" the next morning and found that we had drifted about 150 miles towards Africa, kind of towards 6O1 land or maybe FL8 land. I was thinking of the money I would save if we did drift all the way to Africa because that was the general direction I were heading when I left the Indian Ocean and this would be a cheap way to get there. I asked the captain if he wanted me to summon a towing ship and he said, "absolutely no". The Captain was the only one on board who thought this cabin door could be mounted so it could be used for a jury rudder as he called it. You try sleeping on a drifting boat in the Indian Ocean monsoon and you find that its tough to even stay in the bunk, much less sleep. I don't think many slept on board the few nights we were tossing all over the place. Remember all the decks were loaded and completely covered with those large turtles when all this was going on, no place for a fellow to walk and all those fellows scampering all over the place, trying to not step on those turtles, and no place to step, and after all the decks got wet those turtles started slipping all over the place. Even a few slid overboard too. Some died and began to smell. Oh yes we were having a time on that boat. These turtles have been known to take a bite out of a leg now and then, so no one hestiated while walking over and between them, needless to say. I was on the air of course most of the time telling the boys about things as they were. We were in daily contact with VQ9HB on Mahe, and a number of times the captain talked directly with the owner of the ship. Even the ships owner asked the captain if he wanted a tow vessel sent out to tow us to either Africa or the Sevchelles. To this the captain always said "no". This captain was as hard as nails and like a bulldog. He was not going to give up as long as there was any hope of getting that cabin door mounted in place of that rudder. He was the only one who thought this was possible. Everyone else had a long time ago given up this as out of the question and impossible to be done. Even I had now given up. After three days the turtles really started to smell Q5-S9+ 50 DB, but still they were back there fighting that rudder. And at long last they got it mounted kind of all of a sudden and I think sort of by accident! We were back in business and a ship with a rudder was again on its way to VO9 land.

A message was sent to the ship's owner on Mahe and back came a message telling us a champagne party was planned for all hands upon our arrival to Port Victoria. Back went a message from me saying, "Make Mine, Cokes, please!" Back came a message to me saying, "It's Cokes for you, Mr. Browning". A letter or news item from Harvey Brain was sent to their local newspaper which was very interesting to read. Oh yes, There was a hero in the article you can bet Guess who? The cabin door proved to be not quite large enough and to keep the ship on course the speed of the engine became the directional control. The usual speed as I remember it was about 250 RPM, but to hold us on course it was reduced to about 175RPM. But we were headed towards VQ9, so everyone was happy. I would say a few drinks were consumed on board that night by everyone except me since there was no Cokes on board by now. They had long ago been drunk. It took us about 10 days to reach Port Victoria, with quite a lot more dead turtles on board. We were a smelly crowd when we arrived there. The local police band were on hand to welcome us back to VQ9 land. We were the heroes of the hour. Cases of Champaigne were brought aboard and one full case of Cokes for me with plenty of ice. I sort of would sav maybe a few fellows got drunk that evening on the boat while it was docked there at the "long pier" at Port Victoria. At least that was another one I walked away from, and one more portion of a DXpedition salted away. Back I went to my little thatched hut that's called a hotel room on the north east side of VQ9. The old antennas were put up and on the air as VO9A again I went. The very first QSO I had was with that fellow in EP2 land-he was some high official in the U. S. Embassy or Consulate there and he told me a very interesting story. He said there were some U. S. destroyers in Zanzibar on some sort of tour down in that area and he got a message to them to sort of stand by with helicopters on board to be ready at a moments notice to be able to take off the ship in case we

got into any difficulties and in danger of sinking. I for one was glad we did not have to call on him for help. I am sure Peggy and the kids felt that same way, and especially the insurance companies. It did sort of worry me to think that the insurance companies were worrying. I did not want our DXpedition to end up here because it was just getting started, you might say. There were lots of places to go to yet and operate from. After operating from VO9A for about a week while QRX for a ship to take me to Mombasa, Kenya, I sort of hated to leave VQ9 land with all the beautiful scenery around there. But you know the DXpedition must go on, and this one was not about to stop yet. Everything was taken down, carefully packed, everyone told "good bye". etc. No customs troubles at all. (There is usually none when leaving you know). I was off to Mombasa and then into Africa on the next leg of my trip. More on that next month.



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Technical Aid Group

The first members of 73's Technical Aid Group are listed below. They are willing to help other hams with their technical problems. If you have a concise question that you think can be answered through the mail, why not write to one of the hams on the list? Please type or write legibly, and include a self-addressed stamped envelope. One question to a letter, please.

If you'd like to join the Technical Aid Group and you feel that you are qualified to help other hams, please write us and we'll furnish complete information. It's obvious that we need many helpers in all parts of the country and in all specialties to do the most good. While 73 will try to help with publicity and in other ways, we want the TAG to be a ham-to-ham group helping anyone who needs help, whether they be 73 readers or not.

Don Nelson WB2EGZ, EE, 9 Greenridge Road, Ashland, N.I. 08034. VHF antennas and converters, semiconductors, selection and application of tubes.

Tom O'Hara W6ORG, 10253 East Nadine, Temple City, Cal. 91780, ATV, VHF converters, semiconductors, general questions.

Stix Borok WB2PFY, high school student, 209-25 18 Ave., Bayside, N.Y. 11360. Novice help.

George Daughters WB6AIG, BS and MS, 1613 Notre Dame Drive, Mountain View, Calif. Semiconductors, VHF converters, test equipment, general information.

Roger Taylor K9ALD, BSEE 2811 W. William, Champaign, Ill. 61820. Antennas, semiconductors, product data, gen-

Jim Ashe W2DXH, R.D. 1, Freeville, N.Y. Test equipment, general,

J. Bradley K6HPR/4, BSEE, 3011 Fairmont St., Falls Church, Va. 22042. General.

Propagation Chart

FEBRUARY 1967

J. H. Nelson

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ARGENTINA	22	14	14	7	T	2	14	21	21	21	21	21.
AUSTRALIA	21	14	7*	7.*	7*	7	7	24*	14	34	21	21
CANAL ZONE	21	14	7	7	7	7	14	21	28	28	21	Ž1
ENGLAND	7	*	-	7	ī	ž.	14	21	23.	21	14*	2.4
HAWAII	21	14	7*	T	7	7	7	7*	14	21	21.	21.
INDIA	:	7	7*	2*	7*	7*	14	21	24	7*		14.
JAPAN	14	2.4	2.0	7*	7	7	7	-	7*	7.*	7.*	14
MEXICO	21	14	7	7	7	Ť	7	14	27.	21.	21.	21
PHILIPPINES	14	24	2.4	7.	7.	7*	7*	14	24	14	1.	14
PUERTO RICO	14	3	7	7	7	7	14	23	21	21	21	14
SOUTH AFRICA	14	7	7	7	3.4	14	21	31.	21.	25.	21	2.1
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CANAL ZONE	28	21	\$ €	7	7	7	7	14	21	28	28	28
ENGLAND	7*	7	7	7	7	7	7*	7*	14	21	14	7*
HAWAII	2.8	28	21	14	7	7	7	ż	14	21	28	25
INDIA	7*	14	14	7*	7*	7.	7*	7	14	7	۲٠	7*
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WESTERN LINITED STATES TO

Very difficult circuit this hour.

* Next higher frequency may be useful this hour.

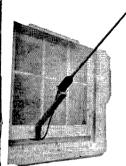
Good: 1, 2, 9-13, 16-22, 28-31 Fair: 3, 4, 5, 14, 15, 23, 24, 27

Poor: 6, 7, 8, 25, 26

VHP DX likely: 12, 13, 21, 27

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TRW Catalog

TRW Semiconductors has just announced their 1967 short form catalog. This 20-page publication lists all TRW transistors, diodes, and other semiconductors. Copies are available from TRW Semiconductors, Publications Dept., 1100 Glendon Avenue, Los Angeles, Calif. 90024.

Jensen Tool Catalog

Hams often have trouble finding the special tools that make electronic construction pleasant. Even the large mail-order catalogs don't carry all of the specialized tools we like. We've recently found out about a very extensive (58-page) catalog of tools that contains just about anything you're likely to want or need from eutectic solder to #80 drills. The catalog includes many standard tools, too. Prices are good, and there's no minimum order. Write for a free copy of catalog 266. Jensen Tools, 3630 E. Indian School Road, Phoenix, Arizona 85018.

Solid-State Communications

Here is another book from the staff of Texas Instruments on the design of transistorized communications equipment. brand new book provides the latest information on the design of equipment using FET's, dual transistors, junction transistors and the latest germanium and silicon microwave transistors. This excellent book covers the entire rf spectrum from high-frequency through UHF; it provides much practical information on the design of circuits and in the selection of semiconductors for these frequencies. Some of the topics covered are small signal UHF circuit design, high input impedance techniques, harmonic oscillators, noise characterization of VHF and UHF amplifiers and VHF measurement techniques. \$12.50 from your bookstore or write to Mc-Graw-Hill Book Company, 330 West 42nd Street, New York, New York 10036.

Drake Converters

R. L. Drake Co. has just announced that they're making FET converters for six and two meters. The converters feature low noise and exceptionally low cross modulation, excellent image rejection and flat bandpass. Each converter uses field effect transistors for the rf amplifier and mixer stages, and regular transistors in the local injection section. For full information of these new converters, write R. L. Drake Co., Miamisburg, Ohio.

Technical Topics

The best, most interesting single book for the average ham might well be Technical Topics for the Radio Amateur, by Pat Hawker G3VA. This book is a collection of short notes, interesting ideas, and hundreds of good schematics about simple and complex, common and unique, useful ham radio circuits. G3VA writes the very popular column Technical Topics in the RSGB Bulletin, and much of the material in the book is from this column. TT is a densely-packed, thoroughly-practical 100-page book every building ham should have. The price is only \$1.50 from 73, or you can order for 10 s. from the RSGB, 28 Little Russell Street, London W.C.I, England.

Transistor Circuit Analysis and Design

The 2nd edition of this famous transistor sourcebook by Franklin C. Kitchen retains all the readability and first, but the many revisions the bring this new volume right up to date. In addition to information on junction transistors, this new book places emphasis on the field effect transistor and its operation, tunnel diodes, controlled rectifiers, unijunction transistors and microelectronics. Fitchen spends considerable time in explaining the fundamental circuit properties of transistors and proper ways of biasing them before proceeding into the design of amplifiers and communications circuits. Many practical examples are used throughout and a knowledge of algebra is all that is required to understand this excellent text. This book is highly recommended to the amateur or technician who wants to know the whys and wherefors of transistor circuit design. \$8.50 from your bookstore or write to the publisher, D. Van Nostrand Co., Inc., 120 Alexander Street, Princeton, New Jersey.

Solid State Sales Catalog

Solid State Sales has a new catalog of inexpensive semiconductors and other parts. It's well illustrated, and contains hundreds of components with good prices. You can get a free copy from Solid State Sales, P.O. Box 74, Somerville, Mass. 02143.

Handbook of Transistor Circuits and Measurements

Most books designed for textbooks and engineering aren't as useful to the ham as they could be. Hams don't want to wade through a lot of derivation of mathematical formulas and such to find a circuit they need, or have to figure out a lot of values on what is obviously a fairly standard type of circuit. That's why the new SEEC book, Handbook of Basic Transistor Circuits and Measurements by R.D. Thornton et al looks so interesting. The book contains practical circuits for about every transistor use you can think of, and even gives parts values and transistors for each. The transistors are specified by general types, such as silicon, high speed, amplifier, which makes it easy to use either the newest, cheapest transistors, readily-available transistors, or surplus transistors, depending on your tastes. The book also includes enough technical material and data on measuring transistor characteristics to make the book very useful to the engineer who wants a good reference. The book costs \$4.50 clothbound, or \$2.65 paperbound, Publisher is John Wiley and Sons, 605 Third Avenue, N.Y. 10016.



Shure Reactance Rule

Figuring out resonant frequencies, reactances, Q's, etc., with the standard formulas and arithmetic isn't much fun. A much easier way to do it is with the Shure Reactance Slide Rule. It's easy to learn, easy to use and easy to buy at only \$1 from the Sales Department, Shure Brothers, 222 Hartrey Avenue, Evanston, Ill. 60204.

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SS611	50-54	7-11	21.95
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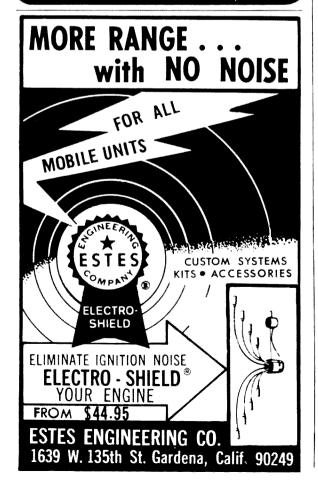
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(W2NSD from page 2)

public servants resting behind their barricaded desks. We made it through in about an hour, possibly an all time record. You have to pay to get out of Lebanon and pay to get into Syria. You pay for yourself and you pay for the car. You pay and pay and pay.

After an hour or so of driving through desert and mountains we began to come to civilization . . . an occasional house built on the side of the hills. An interesting thing: the water supply for these houses came to them via a ditch dug into the side of the hills. All of the houses were below the supply ditch, which went on for miles and miles, winding along so that gravity carried the water. Below the houses was a second ditch for waste.

We arrived in Damascus just before dark and, after driving around for a few minutes to get our bearings, we started looking for a hotel . . . a hotel that had air conditioners sticking out of the windows of its rooms. It was about 90° or so and we'd learned the hard way in Cairo to settle for nothing less than good air conditioning. I never thought I would go into a Hilton hotel, but a couple of nights in the Shepheards in Cairo and I no longer cared if Conrad got a big bite out of me.

Just as we were disparing of finding air conditioners we came across the Hotel Cattans. Luckily they had one cool room left so we checked in. I called Rasheed and announced that we had arrived. His son arrived to pick us up a short while later and we drove up and up the side of the incredibly steep hill overlooking the city. About half way up, just before the slant became a vertical cilff, we pulled up in front of a nice home.

Rasheed and his wife welcomed us. It was still quite warm so we went out on his patio



Rasheed YKIAA

and had some cool drinks, talking ham radio and looking down on the twinkling lights of the oldest continuously inhabited city in the world. Off in the distance we could see the camp fires of the refugees from Israel, thousands of them.

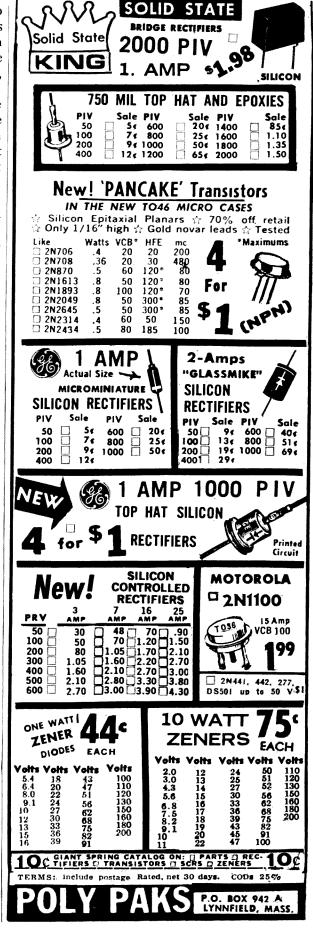
I was most anxious to put YK1AA on the air and see if I could beat down some of the pileups. Rasheed does the best he can with this, but it is very difficult for him, not having been raised in English, to pull out call letters when they are all in a jumble. Rasheed pointed to his three element beam out on the edge of the patio and I could see why he makes most of his stateside contacts via longpath. The U. S. is directly into the mountain for him and very little rf can get through the shield.

I tuned the band anxiously . . . a couple Europeans, nothing more. Damn. My schedule time with my home station in New Hampshire came around so I gave Jim (WA6BSO/1) a call. I1DFL came back and offered to relay for me. Jim was in there, about an S-1, and my signals were about the same. Through I1DFL I found that everything was going well at home. After a few more short QSO's with friends in Asmara, Stockholm, etc., I gave up and returned to Rasheed and the talking. I1DFL had explained that Jim was the only U. S. station that he could hear on the band, so conditions were particularly bad.

Rasheed works at the airport keeping the electronic gear running. He is high enough in the government so he is able to stay on the air during political shakeups, but not high enough so he gets shot. I don't think he is looking for too much in the way of promotions . . . hi. None of the other hams in Syria are permitted to operate.

The next morning Rasheed met Jim and me at the hotel and we walked to the historical museum. The sophistication of some of the things they made all the way back to 6000 BC is amazing. We would be hard put to duplicate some of the glassware they turned out.

Next we headed for the bazaar section of town. I found an ice cream store right off the bat and yanked them in after me. Fellows, it is like nothing you've ever tasted before. They grind out the usual Dairy Queen slush, put it into freezing vats and then pound it with giant potato-mashers so that the crystalline structure breaks down and the ice cream gets very sticky. They serve it by scraping it out of these vats and putting it into dishes with their fingers . . .



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The DXERS MAGAZINE c/o W4 BPD

Route I, Box 161-A, Cordova, S.C., U.S.A. then a little sprinkle of pistachio nuts. Jim blanched at the finger bit, but we put a dish of ice cream in his hand and he had to gulp and eat it. I'll try anything.

We went across the little alley into a souvenire shop. I bought an inlaid backgammon board and a hand embroidered damask table cloth and napkins. I'm not sure why because I haven't played backgammon in twenty years and I don't even have a dining room table. Well, you never know when someone is going to knock on the door and invite himself in to play backgammon . . . I'm ready now.

Rasheed took us into out of the way corners of Damascus where we were able to see craftsmen making all of the usual and unusual peculiar to the city. Things like men sitting in their little stalls turning a wood lathe by hand and holding the cutting chisel with one foot, making parts for chairs.

Lunch was spectacular. Rasheed's son manages the finest restaurant in town and he put on a complete Syrian dinner for us, soup to nuts. The soup was yogurt-like, with egg shaped meat balls made out of meat and wheat, but hollow . . . try making something like that sometime. Delicious. The food kept coming and coming and coming . . . we ate for about two hours . . . smoked egg plant (I hate egg plant, but this was great) . . . mashed chick peas with lemon and sesame oil . . . we waddled out into our rented Simca and, with a short prayer that the odometer would continue to be stuck (it froze on the way over . . . heh, heh), we headed back to Beirut and a cocktail party in our honor by the OD5 gang.

Damascus is a fascinating place . . . most of it is very very old, but newer houses are springing up in the suburbs. Few tourists get there, relatively, and as a result the people are very friendly and smiling. None of this running up with the hand outstretched that we had to continually battle against in Kenya and Egypt. After a while you just hide your camera and stop taking pictures in those places.

The border crossing on the way back was faster . . . only about a half hour plus \$3 each for visas. The damned odometer started working again in spite of our extreme care in not jiggling it. Oh well, it would have been hard to explain the border crossing stamps on the car papers with only half enough miles on the odometer.

Beirut is a rather modern city and certainly the most international in the near east. Their currency is free so you don't have



Bob ODSBZ

to shop around for money bargains on the black market. The only major problem we had with the city was in finding our way around while driving. We had a map alright, but none of the streets have names on them so once you lose your place on the map you are lost . . . and the map doesn't have all the little streets on it so you get lost right away, no matter where you head. It took us over an hour of bumbling around to find our way out going to Damascus and almost as long finding our way back in on our return.

The cocktail party went off just fine and we got to meet about ten of the OD5 gang in person. Lebanon is in excellent shape as far as ham radio is concerned. Licenses are simple to get and there are a goodly number of Lebanese licensed. The other near eastern countries would do well to use Lebanon as an example in business and amateur radio.

After the party at Bob's apartment (OD5BZ), Bob and I drove to his shack, down by the water. It is no wonder that Bob has one of the outstanding signals from this part of the world . . . what a location! I worked about a hundred fellows before calling it a night.

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March 1967

Vol. XLVI, No. 3

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never say die

I see that ARRL is still leaving no stone unturned to try and kill off the Institute of Amateur Radio. They've done their usual thorough job of making sure that the League is the only national amateur organization. Not that the Institute is dead, by any means, it's just a definite unsuccess.

The responsibility for the failure of the Institute to succeed is largely mine. I know when I started it that it would be fought by every means possible by the ARRL and I was sure that CQ would be as truthful as usual in reporting about it. But I am an incurable idealist and somehow convinced myself that enough amateurs would be interested in helping to keep amateur radio going to overcome the barrage of lies and distortions.

Let me go back and explain. As one of the three officially recognized amateur radio delegates to the 1959 ITU conference I had an opportunity to see at first hand the workings of that organization. I was incredulous that amateur radio went into that conference almost totally unprepared. I felt that we had been deceived and completely failed by the ARRL. I watched the two League representatives living it up in millionaire style . . . they managed to spend over \$15,000 of the ARRL funds in just a few weeks. The complete failure of the League to get support for amateur radio, even within the U.S. delegation, was incredible. I talked with the other members of our delegation to find out what had gone wrong and what could be done to see that this didn't happen again.

I'm afraid that they all thought I was very naive . . . and I guess I was. I had not recognized just how important Washington was until then. This is where everything comes to a head . . . this is where it happens. Each of these gentlemen explained patiently to me that amateur radio was at the very bottom of their list as far as priority in frequency allocations was concerned and that it would remain that way as long as

we did not pressure where it counts: on Congress.

They pointed out that every other major user of radio frequencies maintains a lobby in Washington to look after their interests. They wondered if I thought that all this money would be spent on lobbies if they weren't well worth the investment? Then they brought up the fact that every other major hobby group looks after the interests of their field by having a voice in Washington. I certainly can't argue the effectiveness of the American Rifle Association, the Aircraft Owners and Pilots Association, and many others.

Amateur radio, they laughed, has no voice in Washington. But what about the League counsel in Washington? No, son, this gentleman can only represent the ARRL in dealings before the FCC and cannot, by law, approach any Senators or Congressmen in behalf of the League. No, if the League were to lobby for amateur radio in any way they would have to give up their tax-free setup and operate as a regular business. The law just does not permit tax-free organizations to try to influence legislation.

If a voice in Washington is of such great importance, why is it, I asked, that the ARRL doesn't give up its tax-free situation and do the job that will protect our future? They are the obvious ones to be lobbying for amateur radio. The answer was dollars, of course. Loss of the tax-free government subsidy of the League might cost them well over \$100,000 a year, forcing them to either increase the subscription rates to QST or else cut down on the number of high salaries being paid. Neither course is desirable so we have no lobbying permitted by the League.

By 1963, 73 had reached a size where I thought we might be able to get something started to fill in this lobby gap in amateur radio. Time seemed to be growing short too, for in 1959 the USSR came to our rescue and put off the changes in our frequencies until the next ITU conference and this seemed to be headed for us in the late 1960's, leaving not much time for building up support both within the U.S. and internationally. The Institute of Amateur Radio was formed with the major job of lobbying for our hobby in Washington.

It was never the purpose of the Institute to compete with the ARRL as an alternate organization for amateurs to join. The In-

(Continued on page 114)

Editor's Ramblings

Paul Franson WAICCH

Special features

Have you looked through this 73 yet? If not, thumb through quickly. We've got a special feature for you in this issue. It's the book(let)-length article, "73 Useful transistor Circuits." Jim Fisk W1DTY has spent a lot of time and work on this feature; from the looks of the results, the time was well spent, for he's done an excellent job. It will be a rare ham who doesn't consult this section often in his building. If you like it, be sure to drop Jim a line. I suspect that he's got at least 73 more circuits that he could use to make "73 Transistor Circuits part II." In fact, he'd probably like to have your suggestions and contributions for part II.

Our book-length features have been very popular, and we look forward to publishing many more. If you have any suggestions for topics, be sure to let us know. And don't forget that we're in the market for booklength manuscripts. If you have the time and ability, and would like to work on one, please write me with an outline of what you'd like to write about. Preparing a manuscript of this type is a lot of hard work, but very rewarding in both personal satisfaction and in the payment.

Special issues

Next month's issue is our April special. This April, we've got a double bonus for you. First, we'll have a sideband section. It will contain a listing of all commercially available HF SSB transceivers, transmitter-receivers and linear amplifiers. If you're thinking about buying some sideband gear, reading this section is a must! You'll want to study the specifications, descriptions, photographs and comparisons of all the gear. In fact, you'll have a strong will if you don't rush to your dealer or mail in an order for some new equipment after reading it.

The second special feature in April is too horrible for words and too secret to divulge. We can't let the rat out of the bag yet, but we will warn you: Be Prepared. It's even worse than last April's Playboy spoof. I suspect that 777 people will cancel their subscriptions after seeing it.

Our May issue will be devoted to quads. Amateur interest is very high in these excellent antennas, and we've get many good articles about them. They range from a full-size quad for forty to a quad-quad-quad for VIIF. We've also got articles on construction of quads, simple quads, and quad masts. This issue will arrive in the midst of the spring antenna season and should result in many antenna parties around the world as hams decide to improve their signals on both transmit and receive.

June is our surplus month. This year, we're planning to have plenty of good surplus articles and, hopefully, many pages of surplus ads. If you'd like to write a surplus conversion for us, remember: 1. We only want conversions on available gear. 2. We don't want rehashes of old articles. 3. Do it now.

A note to surplus dealers: Start preparing now for our surplus issue. It's the finest opportunity to sell your stock you'll find. If you've got a lot of presently useless stuff, put some clever hams to work on uses for it; maybe it's even worth an article in 73.

This year's ARRL National Convention will be held in July in Montreal in honor of Canada's Centennial and Expo 67. We're going to do what we can to honor the amateurs of Canada by featuring articles for and by Canadian hams in our July issue. Many of the articles will be technical; others will look at the Canadian amateur scene—the ridiculously high prices Canadians have

(Continued on page 116)

Rod C. Rigg W6YGZ 1305 Occidental Ave. Stockton, Calif. 95203

A Transistorized Digital Identification Generator

Here is a description of an exotic, yet very desirable, unit that will send your call or other information automatically without any motors or other moving parts. It can be built for about \$15.

This is a description of a fully automatic, solid state, no moving parts, digital device for storing and generating upon command, a call sign or other message, in the form of dc to operate a keying relay for telegraphy (cw) or a tone to modulate the carrier for mcw. It contains all standard, commonly used, digital circuits; the flip-flop, multivibrator, and diode "and" and "or" circuits. A rough estimate of cost of parts, if you buy components at surplus and quantity prices as we do, totals \$15.

Just what does it do? Briefly, you push the button and it sends your call or any other message that you want to "program" into it. When it has sent the message once, it automatically stops and waits for another command. It is not possible to inadvertantly "erase" the message for it is "built-in" with the wiring of the diode memory. Changing the message is a simple task requiring only:

1) the design of the new diode matrix, and
2) wiring the diodes into their new places. A typical call, such as W6YGZ, takes 47 diodes in the memory.

"Necessity is the mother of invention" and such is the case with the identification generator as we will henceforth call it. We needed a cheap and reliable unit for identifying our transmitters for tests under long periods of unattended operation (within legal limits of course). We had considered

Fig. 1. Graphical representation of the word "at."

the other methods. A tape recorder uses moving parts and the tape wears out rapidly. A code wheel or perforated tape unit also uses moving parts. All require frequent attention to alignment, adjustment, or replacement of worn parts including tape. What we needed had to be reliable for long periods of time, cheap, compact, and capable of changing the call with nominal effort.

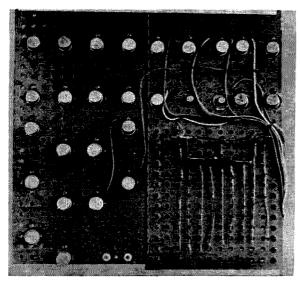
The digital computer approach was favored because of the authors' background and familiarity. The unit was designed using "digital sequential circuit design techniques", a specialized branch of digital computer design, which is a carry-over from relay circuits.

It is assumed that the reader is familiar with the basic digital circuits; AND, OR, FLIP-FLOP, MULTIVIBRATOR, INVERT-ER. Several references cited in the bibliography treat the subject well. The QST, August 1965 article gives a quick review.

A diode matrix was chosen for the memory unit because of the author's immediate familiarity with this type of memory. Different types of memory are presently being contemplated including a fixed magnetic core and a programmable magnetic core type.

A characteristic of this unit which is common to all three types of memory mentioned is that the stored message is changeable; requiring the replacing of diodes in the diode matrix, rerouting sense lines in a fixed magnetic core memory, or simply re-storing a new message in the programmable magnetic core type.

One of the basic questions which arises in the initial design is: in what way should the message be broken down and stored?



Top view of the digital identification generator.

Important criteria in this decision are memory size, circuit complexity, and the ability to store many types of messages. There are three ways in which a message or word can be broken down:

1) By letter, This would require a memory capable of remembering any one of 26

letters, 10 numbers, and certain other characters. It would not require many memory locations. A short message such as a call would only contain 5 or 6 letters and numbers.

2) By character, i.e. dot, dash, or blank. This would require a memory capable of storing one of three possible characters. More memory locations would be needed for the same message than for method 1) as each letter would contain from one to six characters (period has 3 dots, 3 dashes). The call W6YGZ contains 23 characters including spaces.

3) By baud. A baud is a telegraphic unit of time, a dot is one baud, a dash is three bauds and a blank is three bauds (the term is more commonly used in teletype). A unit of this type need only remember one of two characters, presence of a baud or no presence. For example, the letter "a" would consist of a single baud followed by a space baud followed by three more bauds for a total of five locations. An advantage to this system is that only one of two characters need be remembered leading to the binary

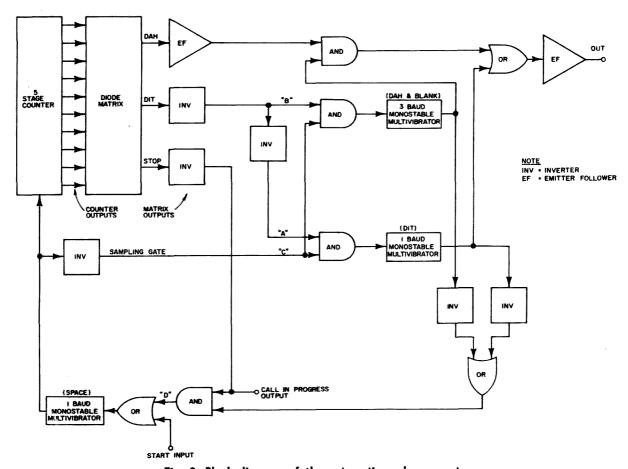


Fig. 2. Block diagram of the automatic code generator.

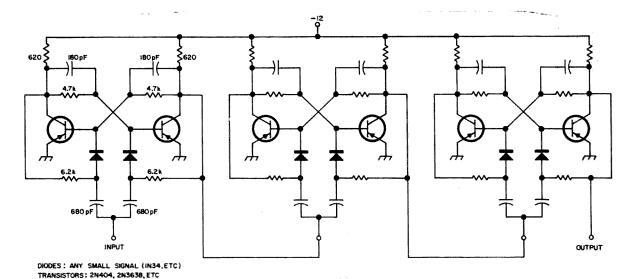


Fig. 3. Typical three stage counter.

system of one, zero, for the memory. The number of locations would be exceedingly large.

Method 2) seemed to be the most practical in light of the criteria involved, so it was chosen for this unit. A memory capable of three characters is only slightly more complex than a two character memory (method 3). The tremendous saving in number of memory locations for a given message is the deciding factor.

Using this method, it is only necessary to build a memory to provide signals which will, at the proper times, trigger circuits generating the dot, dash and blank (no letters). These circuits are simply monostable or one-shot multivibrators with width times of one baud (dot), three bauds (dash), and three bauds (blank).

As an example, consider the message "at". It consists of a dot, a dash, a blank for between letters, and a dash. This is illustrated graphically in Fig. 1. Using the following abbreviations; t = dot, a = dash, b = blank, the memory would be called upon to provide the following signals: t a b a.

So far so good, But there is one more problem; we must provide a short space between characters. If this were not done, the characters would be run together. An additional monostable multivibrator is needed to delay the beginning of the next character until this space time is over. This time is called a "space". It is not to be confused with the blank, which is an absence of a character denoting the spacing between letters. The "space" occurs between characters.

We have established that we need four different time segments corresponding to the four parts of the telegraphic code: dot, dash, blank, and space. Since the length of time for the dash is the same as that for blank, it is a simple matter to combine them into one multivibrator; hence, the dash multivibrator doubles as the blank generator. We need only insure that there is no output during the blank time.

Previously we mentioned memory locations. We prefer to call them states. The capacity of a system is the amount of information it can store and generate and is determined by the number of different states or combinations that system can have. These states are identified by the various values of the counter. Thus, the length of message that can be stored is dependent on the number of counter stages. If the counter contains five stages; then, counting in the binary system, we can determine 32 unique states, i.e. there are 32 possible combinations of counter outputs. Each of these combinations is called a state; and each state can be identified with one character of the message we have stored. 32 bits is enough capacity for most amateur call signs.

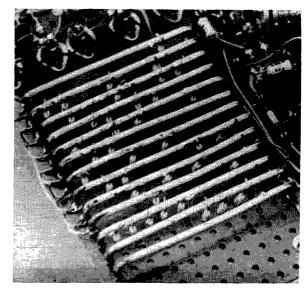
As mentioned previously, this unit was designed using sequential circuit techniques. This means that there is no clock to pace the system; it goes on its own timing. Each circuit triggers the next and so on until it decides to stop. It will be best to keep this concept in mind when reviewing the operation of the system.

Reference to the block diagram, Fig. 2, will show the main components of the sys-

tem. They will be discussed in this order; counter, diode matrix, character formation generators (multivibrators), space formation generator, output circuitry.

The counter, a five stage binary counting chain, determines the particular state of the system and hence the next character to be generated. It consists of five bistable circuits or flip-flops which are connected in cascade so as to count input pulses up to 32 then reset. Outputs are taken from each flip-flop and fed to the diode matrix. A diagram of a typical three stage counter with its interconnections is shown in Fig. 3.

It is in the diode matrix that the message is stored, hence it is the heart of the system. The matrix intreprets each state of the counter and feeds a signal to one of the character formation generators. "Diode matrix" is just a fancy term meaning a col-



Oblique view of the diode matrix that determines what characters will be generated.

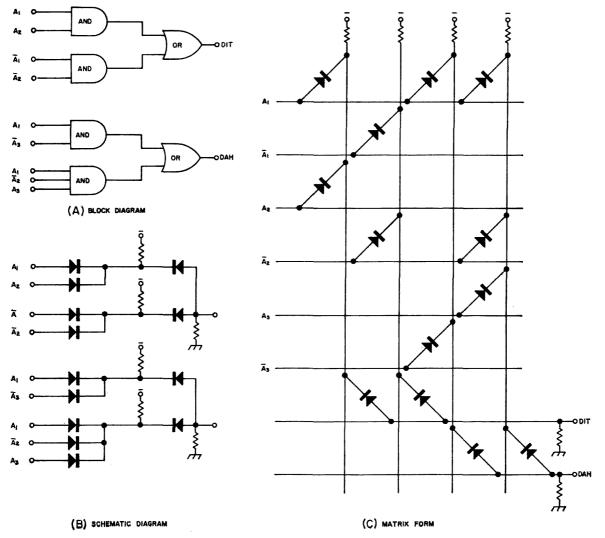


Fig. 4. The diode matrix in three different representations: A. Block diagram. R. Schematic diagram. C. Matrix form.

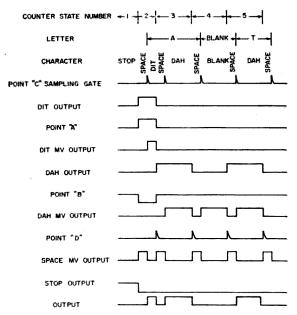


Fig. 5. Timing diagram for generating the word "at."

lection of "and" and "or" circuits that have been arranged in an orderly mammer.

Obtaining the "equations" for setting up the diodes in the matrix is the only complicated portion of the design of this unit. It is necessary to determine the arrangement of diodes such that either output line. dot or dash, has the proper signal or absence of signal for each individual state of the counter. Obviously it is desirous to do this with a minimum number of diodes to keep the cost, complexity, and size down. The actual techniques are a bit beyond the scope of this article. However, they may be found in several of the references in the bibliography. If you are planning on building a similar unit, we will design the matrix for your particular message for a small cost.

The diode matrix is simple in appearance but complicated to design. A typical block diagram is shown in Fig. 4A, its corresponding schematic diagram in Fig. 4B, and the same circuit in matrix form is shown in Fig. 4C.

Simply stated, the diode matrix consists of two level structures of "and" and "or" circuits which select the proper states of the counter and provide outputs during (and only during) those states.

The design procedure involves Karnaugh mapping and writing minimal equations. The matrix can easily be built from the equations.

We have not set a definite charge for the

service. The time required to develop the equations depends on the nature of the message, the amount of "professionalness" of the code desired and the degree to which the design is minimal (i.e. minimal cost). An estimated typical time for a call would be two hours.

We would like to see our device built by someone else and would probably charge only a nominal fee if the person can show a bona fide interest. The design fee is to discourage non-interested persons from wasting our time.

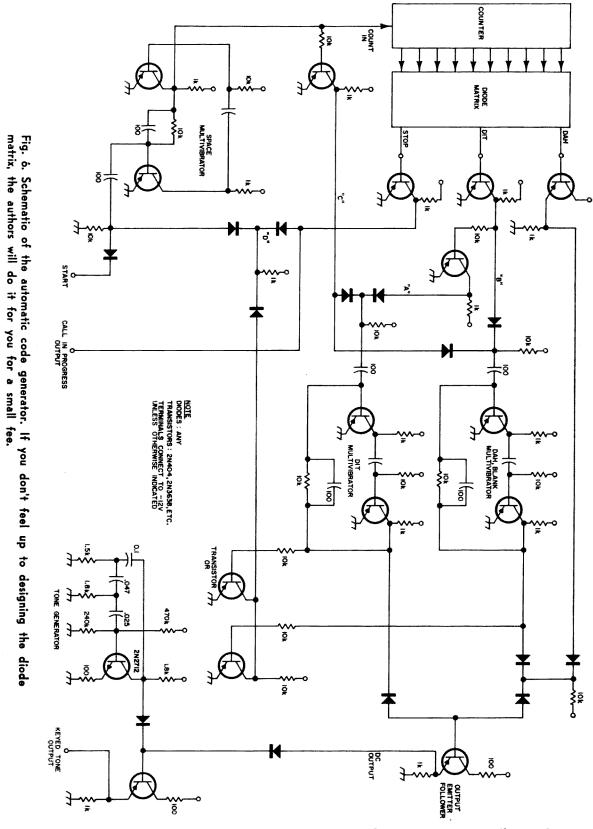
The character formation generators, as stated previously, are monostable multivibrators. These two circuits are triggered by the outputs of the diode matrix. A dot output triggers the one baud length MV (multivibrator), a dash triggers the three baud MV which together with the dash output in an AND circuit causes an output. The blank also triggers the three baud MV but there is no output.

When either of the character multivibrators has completed its function, the space multivibrator is triggered. The space MV, sends a pulse to the counter when it is first triggered. This moves the counter up one state. When the space MV is completed, a pulse is sent to the sampling gates which in turn gates a pulse to either formation MV depending on the output of the diode matrix. And the cycle repeats itself.

The output circuitry simply combines the outputs of the two character formation generators and gates on and off a tone generator for mew or operates a relay for ew. There is provision for inhibiting an output during a blank.

One last thing which we need to mention is a method of stopping the generator after it has sent the message once. The method is simple. A third output from the diode matrix, called a stop, is provided. The stop output occurs after the counter has completed 32 counts. When the counter reaches that state the stop output gates off the space MV input pulses from the formation MVs. This interrupts the sequence and the unit remains dormant until restarted. To start again, a pulse is fed to the space MV. The next state does not have a stop signal so the space MV input pulses are again gated on and the circuit continues thru its sequence.

The entire unit timing diagram is shown in Fig. 5. A careful study will lead to a



better understanding of the operation of the generator. The example shown has been selected to show most of the details of operation. The following events happen in sequence: The counter is initially in the stop state (no. 1). A start pulse fed to the space MV input turns it on incrementing the counter to the next state (no. 2). The diode

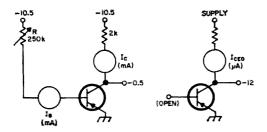


Fig. 7. Circuits for measuring transistor parameters. See the text for a description of how to use these circuits.

matrix interprets this state as a dot. When the space MV returns to its quiescent state, the matrix output is sampled and the dot MV is triggered generating an output. When the dot MV is up, the space MV is again triggered incrementing the counter to the next state. The cycle continues until the stop state again occurs.

Going from block diagrams to actual circuitry; logical levels of "one" are -12 volts and those of "zero" are zero volts. The schematic of our working model is shown in Fig. 6. An understanding of the operation of each of the individual circuits can be gained by reading one of the many texts and articles on the subject of digital circuits. Some of them are included in the bibliography.

It must be kept in mind that we are not dealing with ideal components when building digital circuits; diodes have finite forward voltage drop, finite back resistance, transistors do not have infinite gain nor zero "on" voltage drop. The voltages at each of the logic points are not exactly zero and -12. They are close enough that the circuits still work with good reliability. Keeping the voltages and circuit operation as near ideal as possible is the main criteria in selecting the resistance values for each circuit. Capacitor values determine the timing details. An oscilloscope is handy for debugging the circuits for their final design but is not absolutely necessary.

Typical voltages are not shown on the schematic because each point has a voltage which is continually changing from one value to another. Voltage waveforms at the more important points are shown in the timing diagram.

Obtaining parts at a minimum cost has always been a concern for the amateur. The circuit design of this unit was done with low cost in mind. The surplus market is a good source of resistors, capacitors, and diodes at prices well below the industrial prices you pay for new material.

It is also true that transistors are available at quite low prices but, it has been our experience that the industrial units are more economical and desirable. Most surplus or used transistors are not adequate for digital service and out of a bargain bag of surplus transistors many will not work reliably.

With the introduction of the cheap silicon transistors, it is more economical to consider the industrial units. For example, the transistor used in the identification generator, Fairchild 2N3638, is 31c in quantity. This fact together with the assurance of known characteristics and uniformity of quality makes the choice an easy one. Paul Franson discusses the 2N3638 in his column; 73 Magazine, June 1965, page 88.

Surplus transistors can be used but should be tested first. A few simple tests will determine if a transistor is suitable for use in digital circuits: 1) The dc beta should be greater than 30. DC beta, here, is determined by measuring what base current is needed to produce 5 mA of collector current with the collector-emitter voltage 0.5 volts. DC beta is the ratio of collector current (5 mA) to base current. 2) The leakage current should not exceed 200 microamps. Leakage current, I. is the collector current with the collector-emitter voltage 12 volts and the base open. Circuits for measuring both these parameters are shown in Fig. 7. These are relatively simple tests but they tell quite a bit in comparing transistors. Units that meet these two tests will generally work satisfactory in digital circuits.

Other types of transistors will work equally well. 2N414, 2N404, 2N1305, are just a few. Practically any transistor will work if it meets the above tests. NPN units can also be used if battery and diode polarities are reversed.

Many variations on this idea are possible. Amateurs in the RTTY field might like to consider this unit for solving the problem of dual identification. As the FCC rules stand, only the identification of the transmitting station is required to be in cw. The requirement can be fully met with this generator and a ten minute timer to trigger it.

The ragchewer will find a unit such as this an extension of his "ten minute reminder" (it is suggested that the reader consult the rules and regulations part 97.87 before making final plans).

For the amateur who likes it deluxe, this unit can be the basis for a semi-automated cw station.

With a magnetic core memory many variations of the basic design are possible; for example, several messages can be stored in the memory and called for individually to satisfy various situations. For instance, the following messages could be contained in memory: CQ CQ CQ DE W6YGZ, town, handle, TESTING, 73, and so on. Each could be selected to fit the need. The possibilities are limitless.

For the contest minded (or the novice) a unit with the message: "CQ SS CQ SS CQ SS DE W6YGZ" might be the answer. The message need be stored only once but could be called out three times in a row if a simple three counter is used.

Thanks go to I. S. Reed of the University of Southern California for the idea and background. Photo credit to Rod C Rigg.

Bartee, Lebow, and Reed, Theory and Design of Digital Machines, McGraw-Hill, 1962. A more sophisticated approach to the design of digital systems, covers sequential circuits.

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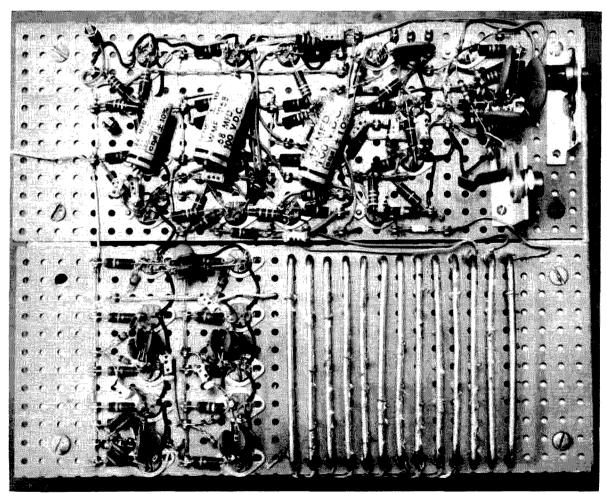
Granberg, H., OH2ZE, "A Push-Button Keyer", CQ Mngnzine 20:9 Sept. 1964, Page 28. Uses magnetic core shift register.

Horowitz, Paul, W2QYM, 'Perfect Code at Your Fingertips'. QST 49:9 August 1965, Page 11. Uses diode matrix and magnetic core shift register. Typewriter keyer. Explains digital circuits.

Hurley, Richard B., **Transistor Logic Circuits**, Wiley, 1961. A College level text explaining digital mathematics, design and circuits detail.

Ketchum and Alvarez, Pulse and Switching Circuits, McGraw-Hill, 1965. A junior college treatment.

"A Semi-Automatic Keyer", an article in **Electronics Experimenter.** Some issue in 1964 or early 1965. Shows how to build a type-writer-like code generator using relays.



Bottom view of the automatic identification generator described in the text. The diode matrix is in the lower right corner.

Sideband Proof of Performance

Have you ever checked your gear to see what it can do? It's interesting, and can often lead to improved results.

Broadcast stations are very familiar with the term "Proof-of-Performance". It designates the series of specified measurements that must be made, set down on paper, and filed with the FCC before a station license will be issued. Though no such requirement is made for amateur stations, compiling a similar set of data will probably reveal many things about your installation which are worthy of correction.

The idea of a graphical analysis of the performance of my equipment setup came about when I purchased a new exciter capable of overdriving my linear. It seemed desirable to construct a pad of approximately three decibels attenuation to correct

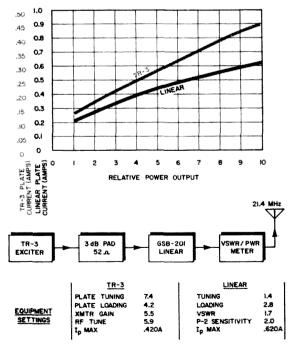


Fig. 1. Plate current of the TR-3 and linear versus relative power output.

the situation. However, to determine the precise benefits, or obtain a quantitative conception of these benefits required some sort of testing. Graphical plotting of the results was the logical approach.

A graph in two-dimensional form shows the variation of a dependent, plotted vertically, when an independent variable, plotted horizontally, is caused to change through a predetermined series of values. The plotting is done after a series of tests have been made at a relatively large number of values of the independent variable and the values of both variables tabulated.

Carrying out a good test requires: 1. a decision as to what items are to be measured, 2. finding an independent (controllable) variable which will put the dependent variable to the test as much as possible, 3. tabulating the results as accurately as possible while the test is being made, 4. putting the results in a form which will best show the variation taking place, and 5. analysis of the results.

Amateur measurements usually fall into the "comparative" class, as access to precise standards is usually impossible and the results are relative to a given set of conditions. Therefore, it is desirable to plot more than one measureable dependent variable if possible in order that accuracy will not depend on any one measuring instrument. Also, the results of one plotted curve can support the results of another, making the analysis more positive.

The results of the first attempt at measurement are shown in Fig. 1 and represent

Bob is a technical director at KFMB-AM-TV. He used to be WOGUY and W8DDT.

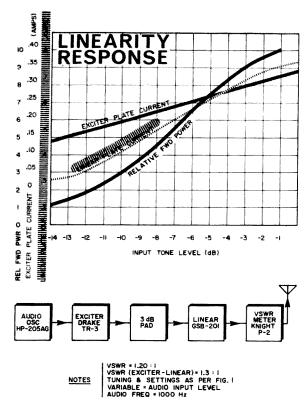


Fig. 2. Linearity response.

a test which could be made quickly and easily by virtually any station with only a VSWR meter with a relative power scale. Carrier is inserted and the level increased as readings of relative power output are taken, along with exciter plate current and linear plate current. This test is informative, but the fact is that the independent variable is not measureable and the results do not show the most important variation, that of power output with input audio level. However it is a reasonably good indication of the linearity of the two stages with drive. An important conclusion from this graph was the fact that the driver (TR-3) reached 450 mA, its maximum output where flattopping begins, at the same time that the linear had only reached slightly over 600 mA. The linear was capable of being driven to slightly over 700 mA before flat-topping; therefore it was obvious that on this band (15 meters) the 3 dB pad presented more loss than desirable. The ultimate conditions was that both exciter and linear flat-top at the same point.

A more valuable test was effected when an audio oscillator was used with the output attenuated to mike level and fed into the microphone input, as shown in Fig. 2. While a commercial unit was used here with

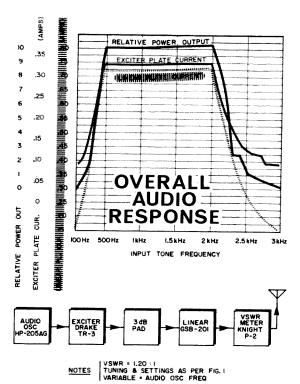


Fig. 3. Overall audio response.

a step attenuator and db level variation read accurately, it is equally as valid to use any audio oscillator in conjunction with a resistor-potentiometer voltage divider to reduce the level and take readings of audio level with a VTVM at the audio oscillator. In many cases, a decibel plot will improve the appearance of a curve over a voltage plot and converting to decibels is not always necessary or even desirable. Use the method of plotting which will emphasize the deficiencies, they are what we are looking for.

In any case, the second set of curves shows that the exciter has become delightfully linear, however on this band (40 meters) it reaches 300 mA plate current when the linear begins to level off. In this case, it would be better to have slightly more padding in order to make the exciter ALC work, thereby raising the average level of rf a few decibels. Another revelation from the curve is the non-linearity in the low plate current region in the linear, a condition which is supported by the relative forward power curve in this region. While non-linearity at this power level is not as serious as at maximum output, it is worthy of some attention in the future.

While the audio oscillator was available it seemed worthwhile to make an overall frequency response run, the result of which

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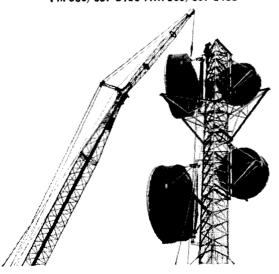
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is shown in Fig. 3. In making this run the input audio at 100 Hz was increased until the linear plate current had ceased rising. It would have been preferable, for observation of the "top" of the response curve, if a slightly lower level had been used since it appears that the leveling-off of the amplifier output has produced an apparent flatness across the response that is "too good to be true". However, the exciter exhibits this same condition and perhaps the actual response over this range is not considerably different from that indicated. The more important aspect of the curve is the steepness of the sides. It shows very definitely the fact that the exciter used the steepest side of the filter response on the side toward the carrier. This results in the response encompassing a greater area of lows. Since the apparent "volume" of the voice is carried by the low frequencies, this may account for the seemingly greater "punch" provided by one transmitter over another of equal power.

The small step is the response of the exciter at 2.7 kHz is interesting but probably rather inconsequential.

I have made no attempt here to "doctor up" any of the results nor to minimize the shortcomings of the test procedures. These are the purpose of testing and it is readily seen how the test procedures can be improved and why. It is also appropriate to remark here that when testing anything it is desirable to write down everything possible pertaining to the conditions of the test, whether it seems pertinent at the time or not. The author keeps index cards in the optimum dial settings and current readings on each band. Also, it is naturally best that tests be made under the same conditions that the equipment is used, and this means into the antenna. This dictates the making of overall tests at a time when the band is dead.

A Non-Tiring CW Monitor.

For anyone who enjoys long periods of CW operation, a good keying monitor is a necessity. Unfortunately, most simple monitors which produce a single tone get awfully hard on the ears after a while and many experienced CW operators still resort to using their receivers as a monitor. They do this because of the pleasing tonal quality of the multi-frequency signal and because one can "play" with the receiver tuning to vary the tone.

It would, of course, be better to have a keying monitor that sounds like the receiver signal and to leave the receiver tuning alone. One can come pretty close to this ideal by use of a dual-tone monitor. Some years ago, I built such a monitor but forgot about it when my interest turned to SSB. Now, with a returning interest to CW, I decided to update the monitor using transistors.

The circuit for the monitor is shown in Fig. 1. The circuit is simply two variable

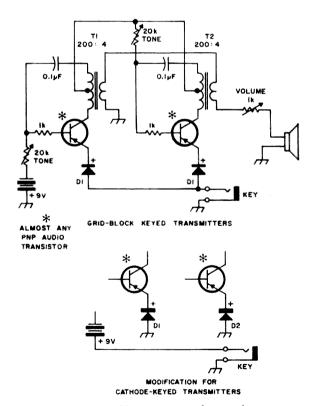


Fig. 1. Two-tone CW monitor designed to overcome the monotony of a single sine wave output monitor. No parts are critical; ell are discussed in the text.

tone oscillators with their outputs connected in series to the monitor loudspeaker. The diodes D1 and D2 protect the monitor from the voltage across the transmitter key terminals. These diodes and the battery connection must be slightly changed as shown for use with a cathode-keyed transmitter.

I used a Telefunken transistor but practically any low-level audio transistor with a B of 50 or more will work. Some examples: 2N138, 181, 186, 217, 223, 249, 270, etc. The diodes D1 and D2 may be any type normal power supply silicon diode units work fine-having a PIV greater than the voltage measured across the open key terminals. A battery supply is shown, however, any operating voltage between 6 and 15 volts is satisfactory and this voltage can usually be "borrowed" from some well filtered point in a transmitter or receiver. If a battery supply is used, the resistance across the open transmitter key terminals should be checked. With some transmitters this resistance is only several thousand ohms and an on-off switch must be used in the monitor to prevent a continuous battery drain.

I built the monitor in a small Minibox measuring 3½ x 2½ x 2½ inches so it could be used as a separate unit for portable operation or as a CPO. It could just as easily be constructed on bakelite circuit board and mounted inside a transmitter. The exact frequency range of the oscillators will depend on the manufacture of the components used but should be about 700 to 2000 Hz. The combinations of tones from two oscillators with this range should satisfy anyone's desire to change the monitor tonal quality.

Although conceived only as a keying monitor, some other uses for such an oscillator suggest themselves: a two-tone test oscillator for SSB measurements and as a CW generator/kewer for an SSB transceiver without CW provisions by feeding the output of only one tone oscillator to the microphone input of the transceiver. For these applications, however, it is essential that the output of each oscillator be checked on an oscilloscope to be sure that it is a good sine wave at the tone control setting(s) used.

. . . WIDCG

Seven Elements on Twenty

Here's a high gain, low cost beam that will really help you get out on twenty meters. Why not join the big boys?

In antenna design, as in boxing, it is true to say "A good big 'un can beat a good little 'un". Tuning across the favorite DX band, 14MHz, proves this axiom again and again as we hear the choice DX returning to the fellows with the big beams mounted on high towers. However, the bigger they are the more they cost, and even though kind neighbors may not object, the financial strain does not allow the average ham the luxury

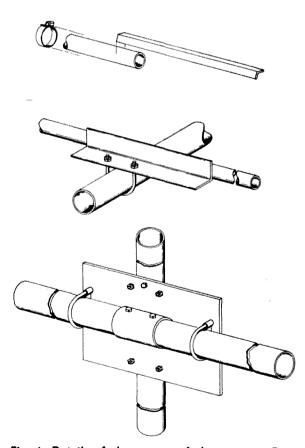


Fig. 1. Details of three parts of the antenna. From the top: Addition of extensions to the ends of the reflector for tuning. Element attachment to the boom. Attachment of the boom to the mast.

of a big antenna. The following description of my antenna is to give some idea of a low cost approach to a large Yagi design on 14 MHz.

The first consideration is the wind load on a large structure—how strong must the beam be to withstand winds to 60 mph? Two approaches were considered. First, a rigid boom using a triangular aluminum tower. Second, a tubular boom with a degree of flexibility to "ride" wind gusts. It was decided to follow the second approach using relatively small diameter tubing, with braces to take the vertical load of the elements.

Sixty feet of boom was selected as a good compromise between cost and performance. For the operator who wishes wide band operation between CW and phone this boom length will allow ¼ wave spacing with five elements. For the phone or the CW enthusiast more elements can be added to give a narrower beam width for better QRM rejection on receive, and a little more gain on transmit. As my antenna was to be used mainly on phone SSB, a center frequency of 14.270 MHz was chosen with seven elements at .15 wave-length, approximately 10 feet spacing.

A visit to the local electrical store produced 2 inch I.D. conduit with .125 inch wall. Two 10 feet lengths were purchased, and a piece cut off each, one foot long, to be used as a coupling between boom sections which are 2 inches O.D. Four lengths of alloy tubing were purchased 2 inch O.D., two at 12 feet, two at 9 feet, wall thickness .065 inches.

Now to assemble the boom on the ground. A screw coupling is supplied with the conduit, so the two 9 feet lengths are coupled together, and two 3 inch, ¼ inch D. bolts fitted through the coupling for added me-

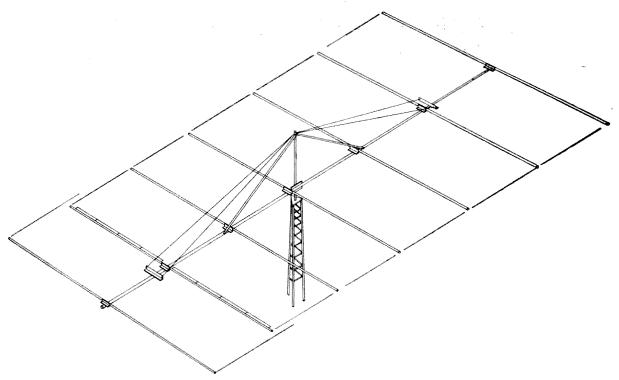


Fig. 2. WA4WWM's seven element twenty-meter beam. Dimensions are given in the text.

chanical security. At either end of the conduit a 3 inch cut is made with a hack saw. Now, a 12 foot length of 2 inch O.D. alloy tubing is inserted in either end of the conduit and a strong joint assured by a 214 inch muffler clamp. These muffler clamps are very strong and cost less than 25 cents each. Six at 2 inch and ten at 2¼ inch were bought from the local auto accessory store. The remaining two 9 feet lengths are joined to both ends of the construction using the two one foot sections of conduit which have been previously slotted with the hack saw for 3 inches either side. This coupling is now made tight with two 24 inch muffler clamps. We now have a 60 foot boom lying on the ground looking extremely flimsy especially when picked up at the center!

Each element is made from alloy tubing. The center portion is the standard 12 foot of 1 inch O.D., .058 inch wall, with another 12 foot of % inch O.D. cut into equal parts, inserted at either end, and still another 12 foot length of % inch O.D. tubing cut in half and inserted into the % inch sections. Now, the beam element is 34 feet long, allowing 6 inches insertion for each joint. Holes were drilled and self-tap screws used to ensure a rigid mechanical coupling. The 34 feet length is sufficient to allow trimming of the driven element and directors, but extra length is required for the reflector, approxi-

mately 9 inches at either end. Two strips of aluminum 1 inch x 12 inches were bent to make ½ inch angle and fixed to either end of the reflector with a hose clamp bought from the auto store. This makes an easily adjustable tuning device.

Various methods of feeding the driven element can be used, but, as K200 UHF twin line was available it was decided to try a folded dipole. Aluminum clothes line wire was spaced 4 inches from the driven element and gave a 200 ohm match to the line. A length of 150 feet of line is used at my location, terminating in a ½ wave coax balun to give 50 ohms to the transmitter. The length of the driven element is obtained from the antenna handbook as 465/F in feet when F is in megahertz. Director #1 was found optimum at 445/F, #2, 3, 4, and 5 progressively shorter to make #5 a 430/F. The reflector should be about 490/F but it is highly recommended that this element be tuned for best front to back ratio.

The elements are now attached to the boom by a 12 inch length of 1½ inch alloy angle fixed to the center of the element with two 1½ inch ¼ inch D. bolts, then the angle drilled to take a 2 inch or 2¼ inch muffler clamp to suit the boom, the three inner elements with 2¼ inch clamps, the four outer with 2 inch clamps.

The element positions should now be

· Technical Sessions

- Exhibits
- Awards

- Women's Activities
- Hidden Transmitter Hunt
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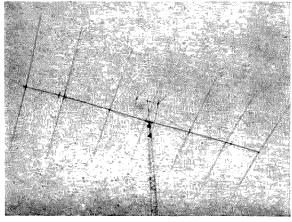
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marked, then the whole antenna disassembled. I use a telescoping tower with 20 foot sections, so winding this down gave a relatively convenient height to reassemble the antenna, using a 20 foot ladder to work at the outer elements.

The center part of the boom is now mounted to the mast, which is rotated by a rotor 3 feet down inside the tower. The mast is 10 feet long so 7 feet remains above the tower. The boom is mounted to the mast, again with muffler clamps on a 4 inch steel plate 18 inches by 12 inches. A % inch hole is drilled through the mast and plate and a bolt used here for added strength. Two 12 feet lengths of % inch tubing are now used to support the ends of the inner 18 feet from the top of the mast, again using muffler clamps. Next, the two 12 feet lengths of 2 inch tubing are assembled to the conduit as before. The ends of these are now supported by cable from the top of the mast. A 2 foot cross bar of 11/2 inch alloy angle was mounted with a muffler clamp and the ends drilled to take the two cables from the mast to either end. Two



A shot of the beam with a small quad over it.

turnbuckles at the mast take up the droop in the boom at this stage. The cross bars give some added strength against lateral forces. Now the remaining two boom sections are coupled to the structure. We now have the boom ready to receive the elements. Assemble the outer elements first, keeping the array balanced, and there is—a seven element beam on a 60 foot boom.

Some remarks on tuning are appropriate. The director lengths quoted are close to the optimum but some trimming of the driven clement may be necessary to ensure 200 ohms. It is best to measure this with an antennascope and a 4:1 bolun to read 50 ohms. This is a balanced system, hence the balun. The reflector can be adjusted with the aid of a small oscillator located a few hundred yards away, or by getting a local ham a few miles away to give S-meter readings. The antenna handbooks will supply details.

Finally, a beam of this size helps tremendously in reception, as the half-power bandwidth is 45 degrees. The gain in theory is about 12 db, but signal reports would suggest that this figure is low, especially when optimum conditions suit the vertical angle of radiation. It is highly recommended that a height of at least 70 feet should be used with any beam antenna, especially after the expenditure of time and energy on a large array.

The antenna described has been in use for a year and has withstood winds of 60 mph with no sign of damage. The cost is much lower than the commercial versions available. Some of the ideas in this article may also be of some use in the construction of smaller Yagis at a relatively low cost factor.

. . . WA4WWM

Climbing the Novice Ladder

Part IV: The code is almost conquered.

On a Saturday morning just two weeks after their last visit to FN's shack, Judy and Joe wheeled into the yard and were surprised to find Larry leaning against the basement door jamb. "Hi, Larry", said Joe, "what you doin' out here . . . goin' to sit in on a code class with us?"

"That's exactly what I am goin to do Joe . . . hello Judy; FN phoned me right after you'd contacted me to be Judy's examiner and suggested that I drop out this morning for an informal session with you kids . . . here I am!"

Just then FN appeared, greeted Judy and Joe cordially and explained, "I asked Larry to come out this morning and we'd put you through a little preliminary examination. Nothing official about it of course; just a run-down to get a double check on your progress. So, if you're all set, let's go inside, set up the CPO and see how your code looks. You bring your headphones this time, Joe?"

"Sure thing" Joe replied, "right here" and he opened the carrier pouch on his Honda and pulled them out along with the license manual. Judy produced the ABC's book which she had picked up and the four of them settled themselves in FN's shop.

"Larry, put on the phones and take a



Joe chose to use his SWL receiver—a military surplus BC-312-N—for his novice operation.

listen to Judy's sending; I'll work Joe over when you're through. Let her send simple English with a few figures and punctuation . . . here, you can take a few lines from one of these books" and so saying FN handed Larry the two little manuals.

Picking a short paragraph in Judy's ABC book, Larry donned the headphones and said, "OK Judy; start right here and send me the first three lines in this paragraph."

FN and Joe remained quiet while Larry copied Judy's sending. When she had completed her stint, FN took the phones from Larry and said, "All right Joe, you send these three sentences from the license manual to me while Larry checks Judy's copy".

ual to me while Larry checks Judy's copy". When Joe finished, Larry looked up saying, "Well, Judy did right well . . . just one mistake girl . . . you sent an 'N' where it should have been an 'A'

"I knew it" Judy exclaimed, "the minute I did it but Gramps had told me not to go back and correct a mistake like that in an examination but to just keep going, so I did".

"Right, Judy", Larry returned, "you'd correct it if you were actually communicating with another station but in an exam you'd just foul yourself up. Incidentally, both FN and I are checking the time it takes you to send the copy we give you; we can then figure your transmitting speed by counting the characters. You were doing very close to six words a minute Judy; so close we won't split hairs".

By then FN had counted the characters in Joe's copy, checked his stop-watch and announced, "By golly, you kids are running practically neck and neck! Joe hit it right on the button at six wpm and also made but one error . . . the old 'X' for a 'Y' again Joe; give those letters a lot more play next time you practice. Looks like both of you made sufficient solid copy a couple of times to have put you through the formal exam but as far as I'm concerned, I'd like to see

you both up to 7 or even 8 words a minute both sending and receiving solid copy before we call the turn formally; what you think Larry?"

"By all means, Larry came back, "if you kids can reach 7 or 8, you'll go through 5 like nothing; give yourselves those extra

few words for a bit of leeway".

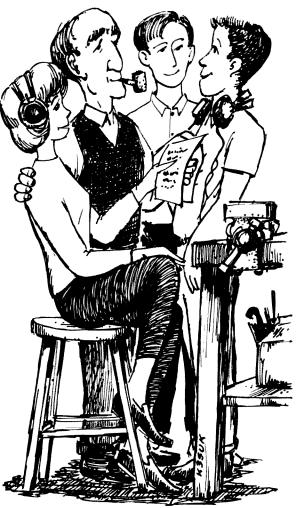
FN then commented, "You should be able to do that in the next couple of weeks if you keep up your present pace . . . just keep plugging. Let's see now what you can do with receiving" and both FN and Larry passed the phones to Judy and Joe.

Larry and FN again alternated between sending and checking copy. Again the two youngsters were very close; Judy had a slight edge and Larry gave her 5.5 wpm whereas FN checked Joe out at exactly 5. Judy generously reminded them that she had a bit more time to practice whereas Joe had his paper route obligation every evening. However, both FN and Larry expressed satisfaction and both were confident that in another two weeks, 7 or 8 words a minute could roll out from under both their fists and pencils. It was therefore mutually agreed that if their knowledge of the written portion of the examination proved equally satisfactory, Larry and FN would administer the formal code examination at the next session, two weeks hence. The written portion would necessarily have to await completion of the formal code test and subsequent receipt of the other papers by FN and Larry. In the meantime, both Joe and Judy, independently, were to write to the Federal Communications Commission at Gettysburg, Pa. and request application forms for amateur radio licenses. They were however, not to complete and return them but were to turn them over to their examiners at the time of the code test.

The code tests for this session having been completed, FN suggested, "Suppose we take up the written portion and see what you know about that in a verbal test; you been

studying your books?"

"Sure, Gramps", replied Judy, "I've been getting in some time every afternoon and I've been reading myself to sleep at night with one or the other of them . . . Joe and I have been swapping them between us. Kinda rough going in spots but Joe's been able to straighten me out on some of the puzzlers so I figure I'm getting the hang of it".



Judy, FN, Larry and Joe talked about receivers after the code practice session.

"Good" was FN's comment, "now how about vou, Joe?"

"Well, FN, I haven't been able to get in as much time as Judy, with my paper route but I think were about even. I've been concentrating on the laws and regulations mostly because a lot of the semi-technical stuff I've had in physics classes and it comes pretty easy".

"OK, then," said FN, "Larry, what say you and I take turns asking them questions at random from the books? You take the license manual and I'll use the ABC's and

we'll alternate the questions".

"Fine" replied Larry, you start if off, FN".

"All right; Judy suppose you tell me what the novice frequency bands are." No trouble here . . . Judy rattled them off like she was using them all every day.

Larry came at her then with, "What is

the maximum legal power allowed novice stations?" to which she promptly replied, "75 watts" but Larry wanted more; "Input or output Judy?"

Looking a bit confused Judy countered with, "Input I think, isn't it? Gosh, I guess I didn't pay enough attention to that."

"Yes, Judy" returned Larry, "input it is but remember you may get a question reading just that way"... what is the maximum legal *input* power.. "and if you were confused between 'input' and 'output' you could go wrong. Have Joe explain this to you more fully some time."

It again being FN's turn, he asked Joe, "What frequency bands can a novice use for radio telephony?"

Joe immediately replied, "145-147 megacycles, only".

After acknowledging this as correct, FN said, let's divert for a moment here; glad this came up. You're right Joe and the use of the word 'megacycle' may appear in your examination or a new term may appear here. Recently a change was mutually agreed upon by industry, educational institutions and scientific organizations. word 'hertz' was substituted for 'cycles per second', therefore megacycle has now become 'megahertz', kilocycle is 'kilohertz' and they've made gigacycle 'gigahertz'. Until the changeover is complete, your examination questions may carry either expression; many of the current manuals and handbooks have not as yet been changed . . . this will take a bit of time. The change was made to honor the memory of Prof. Heinrich Hertz who is the acknowledged discoverer of the phenomena known as 'Hertzian waves' or, as we have more commonly referred to them, 'radio waves'. Just remember that if the word 'hertz' appears where you have studied it as 'cycles', they are one and the same. I'll give you each a card before you leave which shows both the old and the new designations and their abbreviations. Now let's get on with the questions".

After about 45 minutes of this it was pretty evident to both FN and Larry that both youngsters had really done a bit of study ing. Several weak points cropped up of course and they were somewhat hesitant and unsure of the correct answer in replying but in the main, Larry and FN were both satisfied that progress had been excellent. The kids were both cautioned not to

relax their studies and FN would subject them to another informal verbal exam after they completed the code exam at the next bi-weekly session. Just then FN's XYL made her appearance with a heaping plate of freshly baked doughnuts and a pot of coffee, Joe went to the Honda for a six-pack of Coke and FN declared a recess.

While relaxing with this bit of nourishment, Joe broke out with, "Gee, FN; something Larry and I been wondering about for some time and always forget to ask you. We know what the 'FN' stands for . . your 'sine' or handle . . . but how come FN; why not your initials or some other letters?"

FN laughed and said, "Well it's not much of a story Joe. When I first went to work for Western Union as a student telegrapher, I was told that I must choose a two letter combination as my 'signature' to receipt for messages on the telegraph line. My initials, 'DM' would have been all right except that one of the regular operators already used that sine. So I was told to choose any two letter group not then in use and my supervisor suggested something easily recognized and with good rythm. So, I finally came up with 'FN' which in the Morse telegraph code was easy to send and sounded rythmic . . . dit dah dit . . . dah dit . . . that would be 'RN' in the radio code but when I changed over from wire to 'wireless' telegraphy, I was used to the letters FN and it was pretty rythmic in the Continental code as well; just one more dot, like this . . . dit dit dah dit . . dah dit . . . so I just carried it along and I've been FN ever since".

"Should Judy and I have sines too?" Joe inquired.

"You can if you like Joe . . pick your initials or any combination that appeals to you but you'll find most hams and darned few novices will know what you mean when they ask your name and you say 'my sine is YZ' or whatever you have chosen. You'll have to educate 'em to it . . most hams simply use their names. Yours Joe, is hardly longer than a sine would be . . just one more letter and an 'e' at that so you really don't need a sine. On the other hand, Judy's name is kinda long to send though not as bad as many that you'll hear, so if she wants to use a sine, nothing wrong with it. Her initials though are a bit long in code characters . . IM has a dot and five dashes in it . . she may want something shorter and more rhythmic like DA or BR or something."

"How about BK, Gramps?" Judy broke in.

"No" replied FN, "BK is a radio abbreviation meaning 'break' and it would be confusing; don't use anything which may have a double meaning like BT, AR, SK and such."

Judy pondered a few minutes and then came up with, "I'd like to take the Continental code equivalent of your sine Gramps, making it 'RN' . . how about that?"

Looking smugly pleased FN replied, "Sure . . it's OK with me; I don't think any of the boys will take you for a member of the Royal Navy or think you're a Registered Nurse" he finished with a chuckle. From there on out, Judy became 'RN'!

With the little pick-up snack out of the way, FN reminded them that he had promised to talk about the equipment they'd need for a novice station. "Let's start with the receiver; that's the first thing you should have and it wouldn't hurt a bit to get one right now. You could then listen to the many code practice stations sending slowly on the air and to novice and general class hams talking together. Most of them will be too fast for you but in straining to try and keep up you'll find that your



. . . Judy, Larry and Joe parted . . .

code speed will build up a lot faster from the incentive provided by trying to grasp what they are talking about. Always practice by trying to copy a station sending a little faster than you can receive solid; he'll keep you on your toes".

"Now there's several ways in which you can acquire a receiver" FN continued. "First off, you can build one from a magazine or handbook description. I don't recommend this for a beginner and I think Larry will go along with me on this" and Larry nodded in agreement. "First off, today's ham bands are really crowded with stations. That means that you must have a 'selective' receiver . . . one which will permit you to separate them as much as possible. This calls for what we know as a 'superheterodyne' receiver or, as the hams call it more familiarly, a 'super-het'; a good second bet is a really good tuned radio frequency type, again abbreviated ham-wise to 'TRF'. Building either of these is a pretty tricky procedure and after you have it all assembled and wired, it still must be 'aligned' which, to really do right, calls for several special instruments. In the long run you'll have a somewhat mediocre receiver which will cost you about as much as if you had bought a good, standard make, already built and operating. Then too, you can compromise and buy a 'kit' where all of the so-called 'hard work' has been done for you. Holes are punched and drilled in chassis and panel, coils are wound and roughly aligned etc. It's still quite a job to assemble, wire and complete the alignment. An experienced ham can do a good job with such a kit in a relatively short time but the beginner should be wary of tackling it."

"Buying a good, factory-built receiver has several angles also. A really good new one by a reliable manufacturer is going to cost somewhere in the \$150 to \$250 price range. Even better ones go up in price from several hundred dollars to a few jobs selling at a thousand or more! Don't let it scare you though; you are not about to equip 'Gemini Control' but simply making a start in ham radio. You can do rather well with one of the more modest receivers and if it's a fairly recent model of reliable manufacture, it will bring a good trade-in value if and when you want something better later; home-built jobs are rarely accepted as trade-ins."

"Here's another appreach . . . the second

hand market. Many hams who have started with modest gear eventually trade it in for something more elaborate or sell it at a substantial reduction. If of reliable make and it's appearance indicates that it has received reasonably good care, these can often be had for half or less than their original cost. Don't buy a 'pig in a poke' though: most hams are truthful and trustworthy in deals of this kind but are often prejudiced as they have used the equipment for some time, are used to it's little idiosyncrasies and can handle it; a green buyer however could experience rather unsatisfactory results. By all means arrange to try out a piece of gear like this if you're considering buying it and preferably have a more experienced ham look it over and try it out . . . be guided by his opinion. Larry or I will gladly do this for you . . . many of your fellow club members would also be helpful here too, if you find something you think is a good buy. Some of the mail order houses too, offer used equipment which they have taken on trade-ins and have had re-conditioned by their own technicians. World Radio Laboratories is one who specialize in this; there are a number of other reliable sources and vou'll find them advertised in the ham magazines".

"Another good bet in shopping for a receiver is the military surplus offerings. Stores specializing in this as well as many mail order firms who advertise, still have a considerable amount of this kind of gear around at unbelievably low cost when you consider what fine pieces of gear they offer. Again you should rely on an experienced ham in helping you choose something which you won't have to modify extensively for ham

band use."

Right here, Joe broke in with, "Say, FN, a couple of years ago when I was doing a lot of short-wave listening, I picked up a surplus BC-312-N receiver down at Jim Turners' for thirty-five bucks. It sure is a well-built deal and really brings in short-wave broadcasts from all over the world. I often hear amateur radio phones at certain places on the dial and the thing is just *loaded* with all kinds of code signals but I don't know who they are. Could I use this receiver for my novice station?"

"You sure can Joe and it's a dandy; I used one for several years before I got this little Davco solid state job I'm using now. The BC-312 is built like a battleship and

is plenty sensitive and selective to pull ir ham signals from all over the world and you'll find it will fill the bill for you for a long time to come, right on into your general class operation. Only high frequency novice ham band you won't find on it is the 15 meter spread; the BC-312 covers the 20, 40, 80 and even the 160 meter bands in fine shape. When you reach the point where you think you'd like to play around on 15, you can build a simple converter to extend the range of the BC-312 into this band. So, you're all fixed with a receiver for a long time to come . . . how about you Judy?"

"Oh, I'm not so lucky I guess; Dad's got some kind of an FM rig but it's no good for ham bands so I'll have to start from scratch" she replied. "Anyway I've saved a little money this summer from picking berries and a bit of baby-sitting so I guess

thats' a good way to spend it".

Larry chimed in with a suggestion that maybe Judy and Joe could take a look down at Jim Turner's and see what he might have in the way of a good surplus military re-

ceiver or a second hand ham job.

"If you kids turn up something that looks good, I'll be glad to take a look at it and check it over for you. Jim will let you take it home and try it for a few days Judy, I know." Both kids agreed to do a bit of window shopping at Jim's place and the other two electronic stores in town and made a date for the 'great adventure' for the following week.

With the receiver situation pretty well in hand now, FN suggested, "Let's call it quits for today then . . . it's about lunch time for all hands anyway. You young 'uns be out here two weeks from today, sharp at nine a. m. and we'll put you through your code exam. Don't forget now, write a postcard to the FCC and ask for your amateur radio operator license application forms, soon as you get home. Don't put it off or you may not get 'em in time . . . remember, FCC's mail basket is piled mountain high!"

"OK Gramps" Judy replied, "we'll do it" and at Larrys invitation, they tied her bike on his rear bumper and she climbed in with him for the short ride home while Joe kicked the Honda starter and took off after a friendly wave and an exchange of the now familiar "73" . . BCNU . ."

. . . W70E

Going RTTY: Part Four

Frequency Shift Keying

The terminal unit is complete with its scope monitor and you have been getting fine copy.

Now you desire to put a RTTY signal on the air and the question is—how?

Let's first take another look at the terminal unit circuit described in December 73 (1964), and add the mercury wetted keying relay.

The addition to the circuit is the dotted lines in Fig. 1, and only the section of the original circuit covering the 6AQ5 is shown.

This relay will permit you to key the transmitter through the keyboard of your machine, since depressing the keys on the machine will open the loop current and permit the relay to key the frequency shift keying circuit of the transmitter, and at the same time produce local copy on your machine.

The mercury wetted relay shown is the WE276, although others will work as well, with the required socket changes.

The only word of caution is that the mercury wetted relay must be mounted in a vertical position.

Now that the modification is completed, let's look first to the use of frequency shift keying and a simple way of accomplishing it on the average transmitter.

Let's see what we mean by frequency shift keying, assuming that we will employ the standard shift of 850 Hz.

The terms applied to this difference in

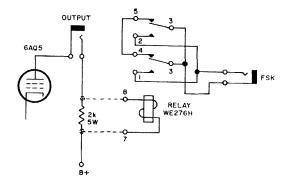


Fig. 1. Adding a keying relay to the terminal unit described in the December 1964 73.

frequency are MARK and SPACE, the first being the RF carrier and the difference in this MARK and the capacity introduced into the cathode circuit of the BFO, is called the SPACE signal.

To illustrate, let's take a frequency of 7137 kHz. This would be the MARK signal. Now to shift this signal down 850 Hz would produce a SPACE signal of 7136.150 kHz.

Now how do we accomplish the change in our MARK signal or the fundamental frequency of our transmitter?

Fig. 2 shows a simple circuit which can be used with most transmitters and others with certain modification, but the principle of creating the frequency shift remains the same.

What occurs is that additional capacity is placed across the LC circuit of the oscillator, which lowers the oscillator frequency sufficiently to move the transmitter carrier frequency 850 Hz.

It should be pointed out that the MARK signal is always the higher of the two frequencies, so that the SPACE signal is shifted downward in frequency 850 Hz.

The slug tuned coil (B) is made of 15-20 turns of about 22 wire on a ½ inch form and tuned to an inductance of about 40 mH. If you are unable to reach the 850 Hz between the MARK and SPACE signal, vary the slug in a (B) slightly.

In adjusting the shift pot it must be done slowly, observing the scope monitor for full deflection on both MARK and SPACE. A little experimenting with this adjustment will make for a 850-Hz setting.

. . . W4RWM

RFC
2.5 mH

SILICON
DIODE

OF OSC. TUBE

Fig. 2. Simple frequency shift keyer adapter for a VFO.

73 MAGAZINE

A Solid-State Product Detector

Improve the performance of your receiver on SSB and CW with this simple transistor product detector.

All receivers not specifically designed for SSB reception suffer, to some extent, in quality and ease of tuning when used for this mode. Distortion of the received signal occurs for a number of reasons. When this includes BFO pulling, reduction of the rf gain may prove necessary. This in turn leads to loss of sensitivity and does not allow the AGC system to operate effectively. This is a less than satisfactory state of affairs.

With the advent of SSB and the almost total disappearance of AM from the HF amateur bands, good SSB reception is mandatory. To date, a combination of hang-AGC and a product detector seems to be the best solution. The product detector is the most important element of this pair and numerous articles have appeared discussing vacuum tube versions of this worthy circuit. There has been very little information dealing with the design of a solid-state version, however.

This article will describe a design which is a transistor equivalent of the popular dual-triode product detector. It will discuss the causes of distortion to SSB signals which include BFO instability as a result of pulling, AGC non-linearity and inter-modulation distortion. As an example of these problems and their cure, it will refer to a product detector built for the Heathkit "Mohican".

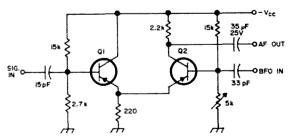


Fig. 1. Schematic of WB6CHQ's simple product detector. The transistors are not critical; IR TR-06's were used in the author's version, which was installed in a Heath Mohican.

In the GC-1A, the primary cause of distortion to SSB signals is BFO pulling. This phenomenon is the direct result of the presence of strong signals in the BFO circuit. In this receiver, the BFO output is injected at the input of the third if amplifier. This is done by connecting a 4.7-pf capacitor from the collector of the second if to a tap on the BFO inductor. Thus, any signal in the if strip is also in the tuned circuit of the BFO to some degree.

To understand why this will pull an oscillator, consider The tuned-grid, tuned-plate oscillator. It may be shown that in this oscillator, the tuned circuit with the higher "Q" will control the frequency. This is so because, a low "Q" tuned circuit having a broader frequency response, more feedback will be provided to the high "Q" circuit. Since feedback is the essence of oscillation, the tuned circuit getting the most feedback will control the frequency of oscillation.

By applying this logic to the BFO, it is easy to see how pulling occurs. If the BFO is treated as if it were a TGTP oscillator, then the incoming signal can be thought of as a tuned circuit with infinite "Q". With this situation the closer BFO gets to the signal frequency, or vice-versa, than, of the two feedbacks present, that from the signal and that from the BFO itself, the more predominate the signal becomes. At some point in tuning, it becomes the controlling feedback and the BFO shifts abruptly to the signal frequency.

When this occurs, the frequency difference between the signal and BFO is necessarily zero. Since the desired audio output is that frequency difference, there can be no audio output. With an SSB signal, the peaks will be strong enough to pull the BFO leaving only the lower amplitude portions of the signal as output. The result is a highly punctuated garble.

With a diode detector, an output of a different but still useless nature is possible. A diode is a non-linear impedance, that is, the impedance varies as a function of the applied voltage or current. A fundamental principle of electronics states that an AC signal applied to a non-linear impedance will generate harmonics of itself. If two frequencies are applied simultaneously, they will also generate their sum and difference frequencies. When a signal as complex as an SSB signal meets a diode, the result is only slightly less calamitous than the famous meeting of the irresistable force-and the immovable object. In this situation, every audio component present may mix with every other audio component to form still more audio components. The result is the muffled, quacking, semi-speech with which we have become familiar with the rising popularity of SSB.

These components are also the output when the BFO locks onto one of the frequencies of an SSB signal. But even if the BFO stays where it should, these components are still present in the output of the diode mixer, because the diode must mix all frequency components present. This is where the product detector has a distinct advantage. It can mix only BFO and signal, rather than BFO and signal, signal and signal, etc. This type of distortion will be recognizable to hi-fi fans as inter-modulation distortion.

The AGC in a receiver can be another source of distortion. In receivers such as the GC-1A, AGC response is fairly fast, capable of following the syllabic rate of an SSB signal or the keying of fast CW. With a perfectly linear AGC, the only effect on an SSB signal will be uniform compression, or overall reduction of the dynamic range. If, however, the AGC response is not linear (which is likely since no tube or transistor has an infinite dynamic range, then the result will be envelope distrotion. This is a rearrangement of the relative amplitudes of the signal components. Normally, this distortion is not too severe as most signals will stay mainly within the most linear portion of the AGC response.

The more important problem with AGC is that, even without modification, it cannot be used effectively. If pulling occurs even with AGC, the AGC is not limiting the signal sufficiently and the only recourse is to reduce the RF gain. When this is done, the AGC begins to lose control and its advant-

ages are gone. It is worth noting that for the GC-1A, Heath recommends that it be turned off for SSB reception.

Theory

The product detector offers a solution to most of these problems. It allows far better isolation for the BFO, reducing pulling to a bare minimum. Being a linear device, it does not experience the extreme inter-modulation distortion possible with a diode detector. Finally, since pulling is not a problem, it allows operation of the receiver at maximum rf gain and use of the AGC. Thus, neither the convenience of AGC nor the receivers sensitivity are sacrificed to the "new wave".

The product detector is more properly known as a multiplicative mixer, the same circuit as is used for a converter in the front end of most modern receivers. This fact will explain the product detector circuits frequently seen which employ a pentagrid converter tube. Another apt name is "audio converter".

To see why and how a product detector works, refer to the circuit of Fig. 1. First, note that the coupling capacitors used have a very high reactance for transistor work, even at 455 kHz. The reactance of the 15-pF capacitor is about 20 kohm and that of the 33 pF is about half that. These high impedances are in series with the low input impedances of the transistors, providing a large voltage division. This insures small signal operation of the transistors guaranteeing their linearity.

This also provides a high degree of isolation for the BFO, which combined with the isolation inherent in the transistor, makes the BFO far more immune to pulling. This immunity is such that in the GC-1A, a local broadcast station about a mile distant, will not pull the oscillator more than about 50 Hz

In operation, Q1 is an emitter follower, whose vacuum tube corollary is the cathode follower. The same conditions hold true for both. They are capable of power gain, but not voltage gain. Since the emitter resistor is common to the emitter of both transistors, the signal is directly coupled to what is to it, a common-base amplifier. In this amplifier, voltage gain is dependent to a certain extent on the quiescent or operating point of the transistor. This operating point is a function of biasing and the bias may be controlled at the base.

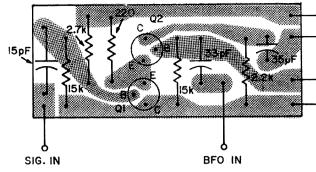
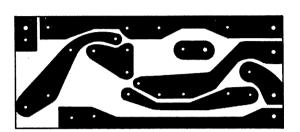


Fig. 2. Layout for the etched circuit board used by WB6CHQ.



Since the BFO is connected to the base of Q2, it is constantly changing the bias and, therefore, the quiescent point at a rate near the frequency of the signal on the emitter. This means that the signal sees a linear input impedance and a rapidly changing voltage gain. This is the reason for the term, 'multiplicative'. Since the output voltage is the input voltage multiplied by the voltage gain, if we must inleude the BFO frequency to express the voltage gain in the equation, then the effect is literally multiplicative mixing.

Adjustment and operation:

This circuit is sufficiently simple that its construction should provide no obstacle to anyone. I have included the PC board layout (Fig. 2) that I used and one can see that I followed the actual appearance of the schematic quite closely. If you wish to make your own layout, this is generally the best method to follow, at least for the smaller projects. I strongly recommend that a PC board be used. They provide the neatest, most compact, best appearing and most durable form of construction available for small circuits such as this. Etching is not difficult and kits are available for it.

Having constructed the circuit, it should be mounted in the receiver and connections made to it. The supply voltage may range from six to twelve volts but be sure that you do not exceed the collector breakdown ratings of the transistor you use. The BFO should be able to supply about .2 volts RMS to the base of Q2 and the signal should not exceed this value at the base of Q1. These values are valid for the circuit when it is correctly adjusted.

o – V_{cc} •5k POT

OAF OUT

OGND

To adjust the product detector, first set the linearity pot to zero resistance (so that the base of Q2 is shorted to ground). With the BFO off, (making sure that the product detector is on adjust the linearity pot from zero until the signal to which your are tuned becomes slightly audible with the volume control on full. A local broadcast station makes an excellent test signal. When the BFO is turned on the signal should be very loud, though not quite as loud as with the diode detector for an AM signal. This will vary with the type of receiver but will probably hold true in most cases. If one wishes to tinker further, the ultimate desired result is a maximum of signal with the BFO on and minimum with it off. The signal present when the BFO is off is a result of intermodulation distortion and is not desired for best reception.

When all this accomplished, it is possible that the BFO will need adjustment to get a zero-beat at the zero-beat mark on its control. In the GC-1A, this is remedied by tuning an AM signal for maximum on the S-meter, setting the BFO at the zero mark, and adjusting the BFO inductor for a zero-beat. Similar methods may be used for any receiver.

In operation, the product detector is virtually identical to the diode detector with the major difference being the improved reception. The BFO is adjusted to one or the other side of zero-beat depending on which sideband is wanted. The signal should show the most deflection on the S-meter when the voice sounds the best. The receiver may be tuned with the RF gain on full and the AGC on.

The ideal SSB receiver is the one on which the only adjustment required is the tuning and sideband selection. When this product detector is used in the GC-1A or any other receiver, operation begins to approach that ideal.

. . . WB6CHQ

AMCOM—

Amateur Mobile Communications

The Phil-Mont Mobile Radio Club, Inc. of Philadelphia and vicinity is endeavoring to complete the outfitting of what it considers a communications facility second to none in AMCOM, Amateur Mobile COMmunications. This is being accomplished through the equipping of an independently powered mobile communications trailer, W3RQZ/portable, with its own prime mover also fully equipped to operate as an independent mobile relay station, W3RQZ/mobile.

Photo 1 shows the com-truck, a 1949 International Metro, and the com-trailer made by the Schulte Company in 1953. The truck was obtained from the Township of Springfield, Delaware County, Pennsylvania, as a former bookmobile. It is now painted a bright emergency red, and well-marked as W3RQZ, Mobile Communications Center. It is well-known to Phil-Monters as the "Red Truck." The trailer was purchased from a contractor whose use necessitated minor body repair topped off with Rustoleum silver paint.

The emergency Red Truck contains equipment mainly for 10 meter AM operation, a 60-watt unit with VFO and tunable receiver,

and a 30-watt fixed frequency unit for operation on the club frequency of 29.493 MHz. This unit can be operated at its position or by the driver of the vehicle. AC power can be supplied by an external generator hauled in the truck. DC power is supplied by a 100-ampere Leece-Neville generating system.

Two other operating positions are available for 2 meter and 6 meter Gonset Communicators, with ac and dc power cords installed. The units are not permanently mounted in the truck, but are available from club members at a moment's notice.

Also included are two telephone line inputs for local and common battery lines; 25 watt public address system which operates on 6 Vdc or 110 Vac; automatic change over for lighting from ac to dc; metering of generator voltage, frequency and running time; handi-talkies on 29.493 MHz; galley supplies; vehicle and other tools; and local area maps. Antennas are available for all equipment, and are mounted in positions for minimum interference between bands.

The communications trailer is Phil-Mont's most refined piece of emergency equipment.

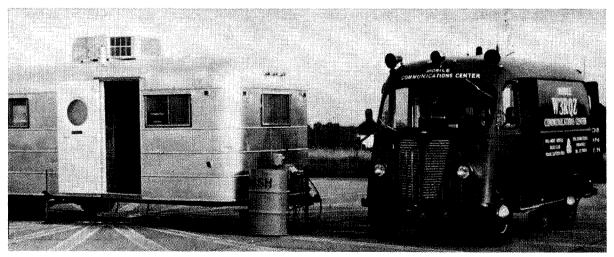


Photo I. The Phil-Mont mobile communications vehicles. On the left is the communications trailer, and on the right, the Red Truck.

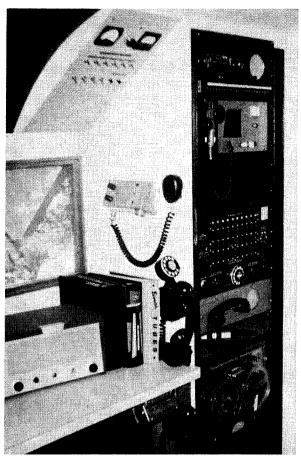


Photo 2. The message center position in the trailer.

Twenty-six feet long, it is divided into an operating area 7' by 14' and a lounge area 7' by 12'.

The operating area walls and ceiling are lined with accoustical tile and are fiber glass insulated. All interiors are white for light reflection, with dark green kick areas. Wall to wall carpeting completes the noise reduction. The lounge area includes a daybed for overnight operators, galley supplies for coffee breaks, and storage cabinets for galley and stationery supplies. The lounge floor is tiled for easy cleaning. Each area has its own door, and eight windows around the trailer provide adequate ventilation when the 1½ ton air-conditioner is not in use.

W3RQZ/portable consists of seven operating positions coordinated by a Message Center Chief. Stationed by the equipment rack at the door between the lounge and operating areas, the Message Center Chief accepts all incoming traffic originating at the portable operating site. He distributes the traffic to the proper operating position for transmission and keeps track of its progress. From his position he has the capability of monitoring, recording or placing on public

address both sides of any or all QSO's in progress. He can also patch any receiver to any push-to-talk transmitter.

On the ceiling to the left of the rack is a power panel which distributes the power to the equipment, lights, and fans. It also provides complete instrumentation of the voltage, current, frequency, and running time of the incoming power.

In the rack, from top to bottom, are: broadcast band monitor; NARCO VGTR-2 for use on aircraft frequencies in emergency situations; message center patching and monitoring equipment; tape recorder; and

public address amplifier.

On the side of the rack is a control-head for 6 meter FM with an RCA CMV-3 on 52.525 MHz and a telephone instrument for use with two incoming lines. Seen on and under the table are speakers and controls for several safety service receivers on both high and lowband police and fire frequencies. The binders contain complete schematics for all equipment.

Photo 3 is a view from the message center position toward the rear of the trailer. In it can be seen an SB-33 for 75, 40, and 20 meter sideband; a 6 meter AM unit; and at the 10 meter position on the extreme right, an Elmac AF-67 and PMR-6. Either microphones and earphones or operator headsets are used with floor switches for maximum noise reduction and operating ease.

Not shown is a Gonset Communicator II, modified for push-to-talk, and a Model 15 Teletype for future use on 80 meter and 40 meter FSK or 6 meter and 2 meter AFSK.

Vertical antennas are available permanently attached for all frequencies but those below 14 MHz. For such frequencies coilloaded mobile whips or portable wire-antennas are used.

Before the acquisition of the com-trailer,



Photo 3. View toward trailer rear from the message center position.

Phil-Mont hauled portable power behind the Red Truck in a generator trailer constructed by club members. This trailer houses a 3 kW-110 volt Onan generator, Model W2C, water-cooled, two cylinder-four cycle, with electric start and ignition. The generator trailer is completely enclosed and has louvered access doors; power cords, junction boxes, jacks, wheel chocks, gas cans, and a power distribution panel complete the installation. This unit is up for sale, but is hauled by other vehicles for present communications projects in the absence of a new Onan Model 305CCK, to be purchased by the club when funds permit. The new Onan will use propane as fuel and will be stored in the Red Truck or any other vehicle used to tow the com-trailer.

Phil-Mont is available with its two vehicles to undertake any communications activity, be it an emergency or a routine project. With a force of Phil-Monters active daily in their own mobiles on 29.493 MHz AM, 52.525 MHz FM, and 3.995 MHz SSB, practice in mobile communications is continual, and leads them to say that Phil-Mont in ready "every single minute."

Inquiries on particulars concerning Phil-Mont's vehicles should be addressed to W3QQH, C. R. Spencer, Jr., 124 Central Avenue, North Hills, Pennsylvania 19038.

. . . K3CEE

Improving the Ham M

I am of the firm opinion that the Ham-M is the finest commercial rotator made . . . mechanically. It is very ruggedly built and, when properly installed, will not be the limiting factor, strength-wise, in any reasonable antenna installation.

My complaint is with the direction indicating circuit. The meter in the control box is calibrated in 5° increments. And the signal which the meter measures is the output of a low impedance voltage divider consiting of a wire-wound pot located in the rotor housing. What could be more accurate?

The catch is simply that the bridge is driven by a dc voltage which is rectified from the ac line through a transformer and is directly proportional to it. What this means is that on a cold day when everyone is using their electric heaters, causing the line voltage to drop, my meter says that the antenna is pointed more to the west that on a "warm" day. Or, since I have poor

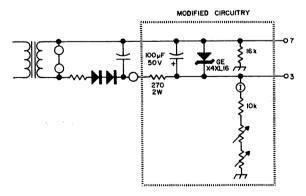


Fig. 1. Circuit of the Ham M control box as modified for consistent directional readings.

line voltage regulation in the shack, whenever I talk the linear up, the direction meter dips to the west.

A moment of head scratching convinced me that this nasty problem should be solved with only the most advanced techniques: a zener diode was called for, to regulate the indicator supply.

A zener diode, you may recall, is the solid-state design engineer's answer to the VR tube. These little gadgets can regulate a voltage with a dynamic impedance of as low as 1Ω or less, far better than a VR tube. They come in lower voltages and a wider range, too. And this is the turning point of the story.

The cover of the control box was removed, the zener diode and the three new parts shown in Fig. 1 were installed and the cover was replaced. A word of caution is in order about the installation of the zener diode. It should be connected "backward", that is, with the cathode wired to the positive line. Connecting the diode incorrectly can not harm anything. The only result will be that the output voltage will be less than a volt instead of 16 volts. The usual caution should be exercised with the electrolytic capacitor.

The results have been most satisfactory. During more than eighteen months of operation, the full scale voltage of the bridge has been checked periodically and found to be right on the nose. And even better—when I talk the linear up, the direction meter doesn't budge a bit.

. . . Galen Tustison WB6FGT



The Classic Feed System

By W. E. "BARNEY" ST. VRAIN, WØPXE

DESIGNING ENGINEER - CLASSIC 33 PROJECT MOSLEY ELECTRONICS, INCORPORATED 4610 N. Lindbergh Blvd., Bridgeton, Mo. 63042.

Code 107

beams several years ago, the method of feeding such antennas has been a subject of much disagreement. When these antennas were introduced a few years ago, Mosley Electronics ran a series of advertisements in the technical magazines explaining the method used on our Trap-Master and Power-Master series. Since that time we have tried a wide variety of feed systems endeavoring to improve on the original system.

Testing Other Feed Systems

In testing, we found a three band gamma system ineffective without isolation networks which resulted in the feed system costing about equal to the antenna cost; system using hairpins, the cost proved low but did not provide a better match than the original Mosley matching system. It became quite clear to us, the Mosley system was hard to beat, for we had found only one slight disadvantage, the elements needed to be stagger tuned to raise the feed point resistance from about 30 to 50 ohms. This slight detuning, which proved advantageous in increasing the bandwidth, brought about, in turn, a slight gain loss of about 0.5 to 1.0 db. at resonance.

The Classic-33 System

In order to give hams a new choice in beam matching systems and an antenna featuring maximum gain with increased bandwidth, we devised the matching method used on our New Classic 33 antenna, a method which takes advantage of the principle that antenna resistance at the center driving point increases as the antenna length increases. Figure No. 1 shows the radiator element of a three element beam at resonance having an impedance at the driving point (Z_A) of about 30 + JO ohms. If the element is made longer, Z_A can be raised to about 50 + J50 ohms. (Figure No. 2) Since the reactance is inductive, it can be canceled with a series capacitor of 50 ohms reactance, leaving 50 ohms

feed point resistance. (Figure No. 3) Series capacitors used on the Classic 33 are made by inserting a suitable length of heavily insulated wire into each half of the element tube at the center. The wires are terminated in a plastic tube enclosure with a type "N" connector for connection of the coaxial cable. To isolate the outer coax conductor from ground, the coax line is coiled for a few turns near the antenna end. This is designed to prevent the very unlikely affect of "Feed Line Radiation".

Fig. 1.
$$L = \frac{\lambda}{2} \qquad Z_A = 30 + j_0$$

Fig. 2.

$$L = \frac{\lambda}{2} + Z_A = 50 + \dot{J}50$$

Fig. 3.
$$Z_{A} = 50 + j_{0}$$

Converting Other Beams

This feed system could feasibly be used on our other Trap-Master beams, but little would be gained and the antenna would need to be completely rebuilt. The big difference between the new Trap-Master beam and the TA-33 is that the latter has conversion features, while the Classic 33 does not. The engineers at Mosley designed the Classic 33 to give the ham a little extra gain on all bands. It is our conviction that discriminating DX'ers will find this new tri bander specifically suited to their needs, but hams buying the well-known TA-33 will still enjoy a superior quality DX antenna with a gain very close to that of the Classic 33.

The Slide Rule Made Easy

The slide rule is a great timesaver for anyone who needs to make a lot of calculations. Here's a simple course in using one.

Are you interested in improving your personal capabilities? Have you given any thought toward mastering the use of a slide rule? Did you, at one time, purchase a slide rule and then fail to follow through on learning how to use it? If the answer to any of these questions is yes, then here is your opportunity to get started on a simple, worthwhile project.

Radio amateurs who are engineering or mathematic students, radio amateurs taking electronic or mechanical refresher courses, and radio amateurs in the electronic, electrical, or mechanical engineering professions readily realize the value of knowing how to use a slide rule. Radio amateurs who design their own equipment will find the slide rule to be an ideal timesaver when they become involved in mathematical processes.

The person who does not use a slide rule for calculations is far less efficient than the person who does use one. For instance, without a slide rule, problems must be written out and the operations performed in lengthy detail by using the rules of ordinary arithmetic. This is very time consuming and the chance of making errors is very high. Sometimes a problem spreads over such a large area that the real point of the problem is lost. Technical people find it to their advantage to be proficient in the use of a slide rule as every practical problem which requires a concrete answer will reduce to a mathematical computation. They find a great deal of time being saved while performing operations in multiplication, division, square roots, etc., on a slide rule and with a fairly high degree of accuracy.

General

What is a slide rule? It is a tool, or an instrument, designed to save time and labor for a person who is performing mathematical calculations. It is the mechanical equivalent

of a table of logarithms. It is a ruler, a type of measuring stick which contains a number of graduated scales arranged in such a manner that multiplication, division, squaring, cubing, extracting roots, and other operations may be performed easily by the manipulation of the rule and the reading of the indications obtained on the scales.

There are several types of slide rules available, and before purchasing one, the user should investigate further as to which one is best suited to his needs or purposes. Your technical associates, or instructor, can advise you as to which one will best satisfy your need. It is better to be advised in advance than to find out later that you possess a slide rule not satisfactory for your purposes. If you don't want to take advice, check a catalog and you will find at least five kinds of slide rules available. Your own judgment may lead you to purchase a rule which is used by physicists or someone above the scope of your purpose. There are trig rules and beginners' rules. There are 5-inch rules, 10-inch rules, and circular rules. So, be careful before you decide which rule to purchase. The vectorlog rule has 27 scales and is generally used to solve problems in electrical engineering physics. The dynamic reactance rule is used in calculations for decibel, inductive reactance, capacitive reactance, resonant frequency, surge impedance, etc. The log log dupli-decimal trigonometric rule has 21 scales including five log log scales and is used extensively when working with logarithms. A trig rule is usually satisfactory for most general amateur calculations, but working with advanced ac theory will require the use of a log log rule.

Complete text books on the use of a slide rule are available and instruction books accompany most new slide rules. This article includes condensed and simplified instructions for the fundamental and basic uses of a

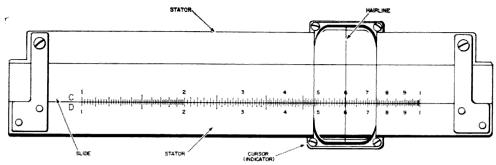


Fig. 1. The major parts of a slide rule with the two most basic scales, the C and D scales.

slide rule and should be beneficial to a beginner.

Slide rule computations for use in electronics are usually more accurate than the tolerances of the circuit components involved. A ten-inch slide rule will give results accurate to within one part in 1000, or one-tenth of one percent when used correctly. As a point of comparison, a good ohmmeter has an accuracy of ± 2 percent and this will lead us to assume that for all practical amateur purposes, numbers used in slide rule calculations may be rounded off to a value which can be easily handled (significant figures).

When working out problems involving ultra-high radio frequencies, the decimal point and powers of ten become involved. A person possessing a good knowledge of working with the powers of ten will have no difficulty in properly placing a decimal point when using a slide rule.

You have now been introduced to the slide rule and it is necessary that you possess a slide rule in order to benefit fully from the remainder of this article, though Fig. 1 illustrates the most common scales.

Construction of the slide rule

A slide rule has three major parts (see Fig. 1):

- (1) the indicator, or cursor
- (2) the slide
- (3) the stator (upper and lower bars) Each scale on the slide or stators is identified by a letter (A, B, C, C1, C1F, CF, D, DF, K, L. LLO, LLOO, LL1, LL2 LL3, S, ST, and T). There are two C, C1, and D scales so that the most commonly used scales will be available on either side of the rule. These scales are found on a log log rule and there will be fewer on a trig rule or on a beginners rule.

If the user learns how to read the scales, how to set the slide and the indicator for each operation to be performed, and how to place the decimal point in the answer, it will then be a simple matter to multiply and divide, to square a number or find the square root of a number, to cube a number or find the cube root of a number, to find the logarithm of a number or find a number whose logarithm is known, and to find the sine, cosine, or tangent of an angle or to find an angle whose sine, cosine, or tangent is known.

Interpreting the C and D scales

The C scale on the slide and the D scale on the stator are the scales most frequently used and are exactly alike. They are the fundamental scales of a slide rule and are used for all general fundamental calculations. Examine the D scale (Fig. 1) and you will see lines and large numerals printed on the stator (1, 2, 3, 4, 5, 6, 7, 8, 9). These lines are called primary graduations. The line labeled 1 at the right end of the C scale is called the right index, the line labeled 1 on the left end of the C scale is called the left index. The distance between 1 and 2 on the D scale is divided into 10 parts. These are called the secondary graduations (1, 2, 3, 4, 5, 6, 7, 8, 9). They are located between 1 and the primary graduation 2. To locate the numbers 12 and 8 on the D scale-8 is found at the primary graduation marked 8, 12 is found at the secondary graduation marked 2 (on the left). The number 14 is the secondary graduation marked 4 (on the left) and the number 19 is the secondary graduation marked 9 (on the left). The number 35 is found at the fifth secondary graduation to the right of primary graduation 3 (3.5 X 10). The number 87 is located at the seventh

secondary graduation to the right of primary graduation 8 (8.7 X 10). The increments of a secondary number are called tertiary graduations. For instance, on the D scale, the distance between 3 and 4 is divided into 50 graduations, each one having a value of 2. The number 3.6 is located 30 tertiary graduations to the right of primary graduation 3, or 6 secondary graduations to the right of primary graduation 3. The number 85.000 is located at the fifth secondary graduation (or the tenth tertiary graduation) to the right of primary graduation 8 (8.5 X 104). If you place the cursor hairline at secondary graduation 2 on the D scale, you will be reading the number 12 (.012, 1.2, 120, 1200, etc.). Place the cursor hairline at primary graduation 9 on the D scale, you will be reading the number 9 (.009, .09, .9, 90, 900, etc.).

Use of other scales

The DF and CF scales are the same as the D and C scales except that they are folded at π (3.14). To avoid the necessity of resetting when an answer runs off the scale, they are used with the C and D scales. The C1 scale is an inverted C scale used in reading the reciprocal of a number. The D1 scale is an inverted D scale the same as the C1 scale. The C1F scale is an inverted CF scale used with the DF scale in the same manner as the C1 scale is used with the D scale. The A and B scales are identical and are used with the C and D scales when finding squares and square roots. The K scale is used in finding cubes and cube roots. The S scale is used when working with the sine and cosine of an angle. The T scale is used when working with the tangent of an angle. Trig slide rules may have a T2 scale for working with tangents of angles greater than 45°. The ST scale is used when working with sines and cosines of angles less than 6°. The L scale is used with the D scale for finding the mantissas of the common logarithms.

Simple multiplication exercises

Get familiar with using the slide rule by calculating simple problems first. The easiest function to perform first is the multiplication of two numbers. Set the left index 1 on the C scale (slide) to line up with the primary graduation 2 on the D scale. Move the cursor hairline to the primary graduation 2 on the C scale and read the result

(2 X 2) on the D scale as being the number 4 (20 X 2 = 40, 20 X 20 = 400, 2000 X 2000 = 4,000,000, .02 X .2 = .0004, etc.). Set the right index 1 on the C scale (slide) to line up with the primary graduation 8 on the D scale. Move the cursor hairline to the primary graduation 7 on the C scale and read the result (8 X 7) on the D scale as being the number 56 (.8 X .7 = .56, 80 X 70 = 5600, .08 X .07 = .0056, 800 X 700 = 560,000, etc.).

Simple division exercise

Division of numbers on a slide rule is the opposite or inverse operation of multiplication. To divide 8 by 4, move the C scale (slide) until 4 is lined up with 8 on the D scale and read the result (8/4) found at the left index point on the D scale as being 2 (.08/.4 = .2, 800/.004 = 2000,000, etc.)

Multiplication of three numbers

Multiplication of three numbers is a little more involved than with two numbers, but is not complicated. Multiply 28.5 X 4.6 X 6 as follows: make an approximation—30 times 4 times 6 = 720. Set the right index 1 of the C scale to line up with 2.85 on the D scale. Set the cursor hairline at 4.6 on the C scale. Set the left index 1 of the C scale under the hairline. Read the result on the D scale directly below 6 on the C scale as 790. Practice will improve your accuracy.

Multiplication and division combined

Find the product of two numbers and divide the result by a nother number. $Try = \frac{24 \times 38}{12.4}$ An approximate answer could be 8. Set 12.4 on the C scale to line up with 2.4 on the D scale. Move the cursor hairline to 3.8 on the C scale and read the result on the D scale as 7.35.

Simple proportion exercises

Here is the easy way to find proportions. Find x if 2/3=5/x. Place 2 on the C scale directly over 3 on the D scale. Move the cursor hairline to 5 on the C scale and read the result on the D scale as 7.5. Find x if 18/x = 3.5/22. Place 3.5 on the C scale directly over 22 on the D scale. Set the cursor hairline to 18 on the C scale and

read the result on the D scale as 113.

Circular measure exercises

Convert $\pi/2$ radians to degrees. Set 2 on the C scale directly over the π mark on the D scale. Move the cursor hairline over the left index 1 on the C scale and read the answer on the D scale as being 1.57 degrees. Convert 45° to radians. Place R (or P°) on the C scale directly over 4.5 on the D scale. Read the result on the D scale directly below the right index 1 of the C scale as .785. We know it will be less than 1 because 1 radian is equal to 57.3 degrees.

Simple trigonometry exercises

It is very easy to calculate circle circumference and diameter. Here we use the D and DF scales. Find the circumference of a circle having a diameter of 4 cm. Place the cursor hairline at 4 on the D scale and read the result on the DF scale—12.57 cm. Find the diameter of a circle having a circumference of 50 cm. Place the cursor hairline at 5 on the DF scale and read the result on the D scale—15.8 cm.

Squaring and square or cube roots

Likewise, squaring numbers and extracting square roots turns out to be very easy. To square the number 3.3, set the cursor hairline to 3.3 on the D scale and read the result on the A scale-10.9. Find the square root of 40. Set the cursor hairline to 40 on the A scale and read the result on the D scale-6.3. The K scale is set up in three sections. Use the left section for finding the cube root of numbers between 1 and 10, the middle section for finding the cube root of numbers between 10 and 100, and the right section for finding the cube root of numbers between 100 and 1000. Find the cube root of 8. Set the cursor hairline to 8 on the left section of the K scale, read 2 on the D scale. Find the cube root of 80. Set the cursor hairline to 8 on the middle section of the K scale, read 4.3 on the D scale. Find the cube root of 800. Set the cursor hairline to 8 on the right section of the K scale, read 9.3 on the D scale.

Logarithm exercises

A slide rule reads only the mantissa of

common logarithms and the characteristic is to be calculated. Find log₁₀ 3.14. Place the cursor hairline at 3.14 on the D scale. Read the result on the L scale directly under the hairline as 0.497. Find log₁₀ 887. Place the cursor hairline at 8.87 on the D scale. Read 0.948 on the L scale. Add the characteristic 2 and the answer is 2.948.

Working with the trigonometric functions

Trigonometric functions are readily determined by the use of a slide rule. Working with these functions involves the use of the C, C1, D, S, T, and ST scales. Examination of the S, T, and ST scales shows each identified graduation as having a double set of numbered graduations. On the S scale, which will be used with the C or D scale, the left hand (black) graduations are/angles between 5.7° and 90° to be used with sine value calculations. The right hand (red) graduations are angles between 5.7° and 84° to be used with cosine value calculations. Find the sine of 15°. Set the cursor hairline to the black 15 on the S scale and read 0.259 on the D scale. Find the cosine of 60°. Set the cursor hairline to the red 60 on the S scale and read 0.5 on the D scale. If the sine value is 0.96, what is its angle? Set the cursor hairline to 9.6 on the D scale and read 74° on the S scale. On the T scale, the left hand (black) graduations are angles between 5.7° and 45° to be used with tangent value calculations. The right hand (red) graduations are angles between 45° and 84.3° to be used with cotangent value calculations. The tangents of angles between 5.7° and 45° are read on the C or D scale and those between 45° and 84.3° are read on the C1 scale. Cotangents of angles between 45° and 84.3° are read on the C or D scale and those between 5.7° and 45° are read on the C1 scale. Find the tangent of 31°. Set the cursor hairline to the black 31 on the T scale and read 0.6 on the C or D scale. Find the tangent of 70°. Set the cursor hairline to the red 70 on the T scale and read 2.75 on the C1 scale. The ST scale is used when working with sines and tangents of angles between 0.5° and 5.7°.

The author used a Lafayette 99-7031 10inch log log dupli trig slide rule in the above trig function manipulations. More detail could be given towards this type of coverage, but since not all slide rules are

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alike, it would benefit the user more to study the examples given in the book which accompanies each new slide rule.

Log log scales

The LL scales on a log log rule represent a logarithm of a logarithm. The LL1, LL2, and LL3 scales range in values from 1.01 to 20,000, are used with the C and D scales, and give the natural logarithms of numbers greater than unity. The LLO and LLOO scales range in values from 0.0001 to .999, are used with the A and B scales, and give the natural logarithms of numbers less than unity.

Using the c, P° , and π gage marks

Near the left end of one C scale and near the end of one D scale you will note the small letter c. This represents 1.128 and is used when calculating the area of a circle. Find the area of a circle having a diameter of 1.4 cm. Set the cursor hairline to 1.4 on the D scale which does not have the letter c on it. Place the letter c on the C scale under the hairline. Move the cursor

hairline to the C scale left index. Turn the slide rule over and read the area on the A scale under the hairline as 1.53. The P° mark found on one of the C scales and on one of the D scales represent 5.72958 and is used when converting an angle from degrees to radians. The π mark found on the C, D, CF, and DF scales represents 3.1416 and is a ratio of the circumference of a circle to its diameter.

Conclusion

Much more could be written about the use of a slide rule but this article is presented with the hope of inducing amateurs to become familiar with the benefits to be gained by using a rule. More difficult exercises and information pertaining to the care and maintenance of a slide rule are usually contained in the book which accompanies a new slide rule. After some concentrated practice, one should be able to multiply, divide, handle square and cube roots, and some of the trig functions very easily. For those who wish to go further, it is recommended that they obtain a textbook covering all of the uses of a slide rule.

... WIMEG

How to Make Better Panels

Do all of your construction projects seem to look horrible? Here are some good hints that will help you make them attractive.

What does your home made gear look like? If your work resembles much of mine, you may not be too eager to show it to the public eye. For some time I've used a simple ink-marking process on bare aluminum which is adequate but harsh and prone to glare. It was passable, but I felt persistently unhappy about its overall appearance. This article describes one of the ways I finally worked out for making more satisfactory panels.

You won't need any special tools or machinery. There are no chemical processes, although some time is required. The finished panels can be very colorful, and a few of mine are. Ten dollars should put you in business for the next two years or more, and the finished panels really do look good!

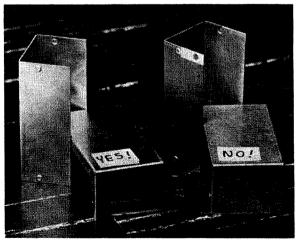
Materials Required

• 1. A scraping knife, a rather fine file, and some emery cloth.



These are the materials used in making panels. Most of them are very easily obtained from local hardware stores, supermarkets, and bookstores.

- 2. A sheet of fine grade wet sandpaper. A fine-textured abrasive on waterproof backing, used wet. The water prevents removed metal from building up little islands which clog the paper. Try some dry and see.
- 3. Kitchen detergent, stronger varieties preferred.
 - 4. Denim rag.
- 5. Large cardboard box and some cheesecloth, scotch tape and safety pins.
- 6. A few odd pieces of brick, wood, or pipe.
- 7. Rustoleum spray enamel, about \$2.00 per can. Their + 975 gray is good to start, and you might like to purchase other light colors later.
- 8. Draftsman's lettering supplies: ruler, pens, and waterproof India ink.
 - 9. Rustoleum #717 clear spray enamel.
 Purchase emery cloth and wet sandpaper



Choose unpainted metal parts for construction, and save yourself the trouble of cleaning off the manufacturer's inexpensive soft paint.



Simple spray booth. Maybe ten cents in materials. Store it front down to keep dust out.

which feels abrasive but not toothy to the touch. Different manufacturers use different grading systems so I haven't recommended a particular degree of roughness. Since you're not going to really lean on it, the scratches won't be deep and the grade you use is not critical.

Preparation

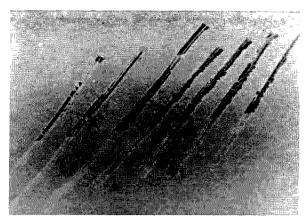
If you want a good job, the surface to be painted must be *real* clean. You have two foes: grease and dust. Grease spoils paint adhesion, and dust results in a relatively huge mound in the finish for each tiny particle. I hope you'll begin by practicing on some scrap metall

Surface preparation starts with the purchase of the chassis or panel that is to be painted. Choose aluminum with a natural or unpainted finish. This saves solvent problems or a trip there and elsewhere for somebody who can get it off for you.

You can make guide scratches on the panel surface during construction. But they mustn't be deep! Although I've never tried it, I suspect a good epoxy auto body filler could fill in some pretty deep gouges. An ordinary nail is hard enough to take a good point for working on soft aluminum, and will not need frequent resharpening.

When the construction work is done, go back over the chassis or panel to clean up the edges, corners and holes. A good knife, used carefully, will pare out the rough edges that usually appear around holes. A fine file can round off sharp corners and feather edges left by dull shearing tools. You may want to give the work a first finishing from a small piece of emery cloth.

Then make up a strong detergent solution and wash the work thoroughly. Use a



This piece of scrap metal was cleaned over all and then sanded on the upper portion only, before painting. Test scratches made with the edge of a sharp knife show good adhesion on the sanded part.

wad of denim as a washcloth, and scrub all surfaces twice, whether they get paint or not. This removes grease which could be carried around to the painted surface just ahead of the enamel. Rinse thoroughly, and by now your hands should be very clean too.

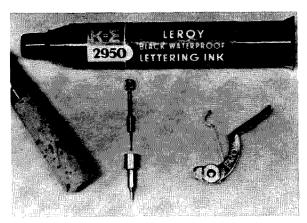
Still using warm water, have a go with wet sandpaper at the surfaces to be painted. Use only moderate pressure. Rub up and down, diagonally, crosswise, and in circular directions. The surface should take on a dull whitish-metallic sheen with no strongly preferred direction of marking. The enamel sticks very well to metal surfaces treated in this way, so that no primer is required. I've tried it both ways.

When you're done with this, shake off the excess water, wipe with clean paper towels, and put the work in a warm place to evaporate the last traces of moisture. When dry, wrap it in a clean newspaper and you can store it without deterioration of the surface.

If you're in a hurry, you can shortcut the following process by marking directly on the cleaned surface with India ink. Then spray clear enamel over all. Or you can apply clear fingernail polish over the labels and have your work back on the assembly bench in about a half hour from starting.

Spray Painting

Try to arrange things so you can do the entire job without moving the work. If you're painting a box or other many-sided surface, think about how you will move it when it's wet. You'll soon accumulate a few wood



Take this with you when you go looking for lettering supplies. Here are a pen holder, a Leroy adapter, one of the Leroy lettering tips, and a very convenient ink dispenser.

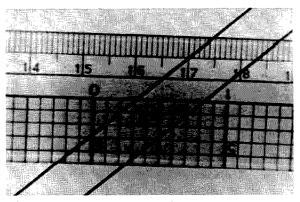
blocks and other objects for propping things in place. A panel or chassis will rest nicely on top of a piece of pipe and can easily be rotated to get at all sides.

The Rustoleum enamels I've been using are well behaved, and flow very nicely a few seconds after going onto the metal. The object is to get just enough everywhere to cover the work. Avoid overdoing by putting on a coat that's visibly too thin. Estimate your progress and then put on a little more. Corners seem to need special attention.

Those handy spray cans will generate an awful mess. I don't think spraying outdoors is practical, so here is a way to keep the stuff under control. Find a cardboard box fifteen inches or more deep and large enough so your work doesn't seem cramped in it. Put in three or four layers of cheese-cloth a few inches from the closed back. Scotch tape will do the job and a few safety pins may help. With some newspapers over the adjacent bench, you will have a spray booth that works much better than you'd believe without trying it. The cheesecloth reduces the disturbance of spraying and catches most of the waste spray.

The Rustoleum people suggest spraying from a distance of a foot or so. Start the spray off target, and then swing it across the work. Keep it moving! Spray, check, and spray again. With practice you can learn to paint a vertical surface with little or no bead developing along the bottom edge.

You'll find a little note on the spray



Closeup of a convenient scale for drawing guidelines. Two parallel guidelines included.

can about cleaning the nozzle when you're done spraying. I have a three-year old can of spray which works fine. Another didn't get cleaned properly some time, and it doesn't work so well. Be sure to clean the nozzle as per instructions!

When you're done spraying, get right away from the work. Come back next day. Some heat will help things along if you're in a hurry. But this will increase the chance of dust, dirt or damage. I have done the complete job in one day, but a slower approach will give nicer results.

When the work has dried sufficiently, almost anything that will apply ink to paper will serve for labeling. I generally use a Leroy pen set. Bookstores, paper supply houses, and many other businesses carry drafting supplies which may be usable. Try Speedball products. Lettering jigs and guides that work well on drawing boards are less successful on real panels with their holes, screw heads and other obstacles.

Why not learn draftsman's lettering? Good books on drafting devote a chapter or two to the subject, or little, soft-cover pamphlets come complete with neatly marked practice pages. One of these is well worth 50c or so. Practice a little bit every day . . . you will find yourself using your neat new lettering on schematics, notes, and other applications as well as shiny fresh panels.

Rough out your panel before you mark it up. Almost every time I omit this simple step I regret it. Just make up a freehand sketch about full size and write the lettering on it in pencil. Revise until it looks right to you. Don't get fouled up in rules of proportion and all that.

Then you're ready to put lettering guidelines on the panel. A dull-pointed tool, which will scratch but not penetrate the soft enamel is required. If not overdone, these lines will disappear when you apply the clear finish coat. A nail will take a good point, use it gently! A transparent five-and-dime ruler with parallel guidelines on it serves to get your parallel lines in place. The lines should be just strong enough to be visible through the ruler. Wash the ruler just before using, and keep fingers and hands off the panel. A handy sheet of paper enables you to rest your hand where convenient.

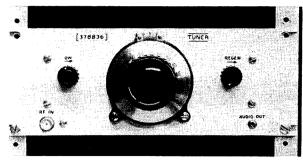
I use a Leroy pen for lettering. You'll probably want to start with a #1 and a #3 point, and pick up a #0 and a #2 later. These odd-looking devices are very good once you get used to the loose piece in the center. This serves to keep the tip from drying rapidly, as it does in a conventional pen. If the tip does seem dry, jiggle and rotate the center piece til the ink flows freely. The flattish working ends are relatively immune to digging into the work.

Choose the larger point for larger lettering to avoid a spidery appearance. Mount the pen in the holder and go at the panel, just as in practice with a pencil. If you can't make out the guidelines, change the lighting a little bit. They should be just visible as white against darker, rather than the usual dark against light seen on paper.

If you make a booboo, and we all do, a handy Kleenex dampened with a little spit will rub out the mistake. Then blow some humid breath on the panel, and wipe off the fogged region with a piece of dry Kleenex. Do this one or twice more. This gets the last traces of spit off, so the new lettering is the same weight as the uncorrected lettering nearby. If you don't do this, it will be heavier.

A grease contamination far too thin to see will spoil the fresh enamel's excellent wetting properties. Have a few pieces of clean paper handy and keep most of the panel covered while lettering. You may get so involved with neat lettering your hand wanders off the protective paper. Sorry about that!

When the lettering is finished, set the panel aside to dry for a few minutes to a half hour before going on to the clear enamel finish coat.



This panel was completely finished in one day. Slight crinkling of the finish at one point probably does not show in magazine copy of photo.

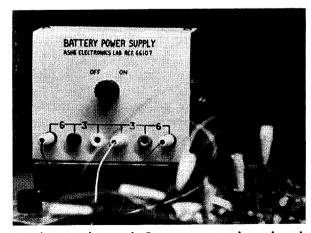
Finishing up

I once applied lettering and finish coat eight hours after enameling, with the help of heat for quick drying. But I recommend a drying period of at least 24 hours in a warm place. Try your luck on some scrap. If the color coat is insufficiently cured, it will wrinkle free of the metal when the finish coat goes on.

After the finish coat has hardened for at least 24 hours, you're ready to go ahead with final assembly of the project. Be nice to the fresh, soft enamel! If you wash your hands and wipe tools with a paper towel just before starting work, the whole project will stay quite surprisingly clean.

As a nice final touch, if you want to wait at least another 24 hours, the enamel will take a coat of auto body wax. Car painters like to have you wait a month or more, and I think they use materials similar to mine. Well, this wax finishing really puts the grand touch on. You'll be very pleasantly surprised at your results, and it really is worth the time it takes!

. . . W2DXH



Another simple panel. Oops, seems to be a breadboard in there.

An Automatic Keyer Using Intergrated Circuits

Here's a very simple integrated circuit keyer that uses very few parts.

This article describes one of many possible applications of integrated circuits to amateur radio. The keyer described is self completing, completely adjustable from less than one word per minute to sixty words per minute, and could be built in a pocket match-box. The complete keyer can be built for less than thirty dollars (\$30.00).

Operation

A clock generator consisting of a unijunction transistor and an R-C combination is used to determine the speed of operation. The basic relation of a space equals a dot, and a dash equals three dots was used and is constant regardless of the speed. The clock pulse is connected to the dot flip flop through the logic built into the flip flop package. The output of the dot flip flop drives the dash flip flop. The output of both flip flops are connected to a gate which has an output if either of the inputs go to zero.

The output of the gate in this keyer is used to drive a transistor to control a relay. It is possible to use a transistor only and build in weighting circuits to give individual desired effects; but, the emphasis of this article is on the application of the integrated circuit.

Texas Instruments integrated circuits were available at reasonable prices and were chosen for this application. The SN7302 package (.125 X .250 X .035 inch) contains two flip flops and all of the necessary logic circuits required for proper gating. (38 transistors total) The SN7360 quadruple two input NAND/NOR gate contains 24 transistors total in the same size package. Only one of the four gates in this

package is used.

The integrated circuits operate on 3 to 4 volts dc. The minimum voltage which will operate a unijunction transistor properly is 9 Vdc, therefore, a 5.6-volt zener diode is used to drop from 9 Vdc to 3.4 Vdc. The zener diode was chosen over a divider in order to maintain a low power supply impedance for the integrated circuits.

Circuit description

Refer to the schematic diagram. Fig. 1, and the logic chart, Fig. 2. The capacitor C3 charges up at a rate determined by the speed control R1 and R3. When the voltage across C3 reaches the intrinsic stand-off ratio of Q1 (firing point) C3 is discharged through R4. This provides a positive pulse several milliseconds long with an exponential decay. The flip flops trigger only on the trailing edge of the clock pulse so this signal is passed through C5 and R5 to provide a fast rise and fall pulse.

The terminals marked on the schematic with an asterisk are the dot flip flop. The flip flop operation is as follows: Q. HAS A 2.5 V. output and \overline{Q}_{\bullet} (pronounced not Q) is at zero. If K. is positive when a clock pulse is applied to CP. the flip flop switches and Q. and \overline{Q}_{\bullet} switch modes. Since J. is connected to +3 volts the following clock pulse reset the flip flop to its original mode. This action represents a dot and space. If the dot key is held down the next clock pulse simply triggers the flip flop again and if the key is released the next pulse resets the flop flop to a space condition and it remains.

The terminals of the SN7302 without an asterisk are used for the dash flip flop.

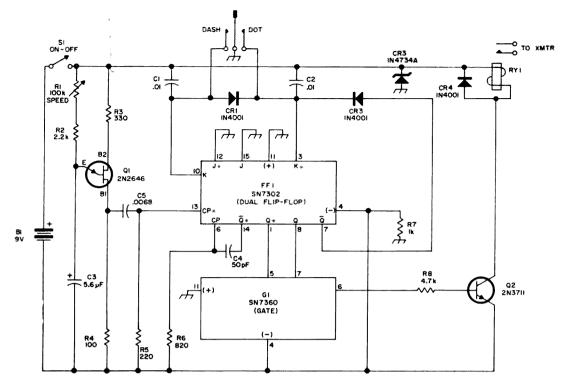


Fig. 1. Schematic of W5FQA's integrated circuit keyer.

The dash operation is as follows: The key is moved to the dash position and a positive voltage is applied to K. through CR1 starting a dot sequence. Q. goes positive at the start of the dot. This positive signal is differentiated by C4 and R6 providing a fast rise and fall pulse at CP. (The clock pulse input for the dash flip flop.) The input at CP triggers the dash flip flop causing O to go positive since K is positive. The next clock pulse triggers the dot flip flop, but it will not trigger the dash flip flop until Q. goes positive again which is the following pulse. Then the dash flip flop changes state, but the output of the dot flip flop is still present and will remain for the length of a dot which gives a dash length of 3 dots. If the key is released before a dash is complete a positive voltage is still applied to K. through CR3 which makes the dash self completing.

The operation of the gate SN7360 is as follows: If either and/or both inputs are zero the gate has an output. If both inputs are positive the output is zero.

Information about the integrated circuits used in the keyer is available from Texas Instruments, P.O. Box 5012, Dallas 22, Texas. Request bulletin No. DL-S 657650, July 1965.

Construction

The authors keyer is constructed on a Vero printed board, however, for one who does not have an integrated circuit soldering iron the TI Mech-Pac connectors are ideal. Wiring is not critical and phono wire or #30 to #32 hookup wire is recommended.

The positive 3 volts for the integrated circuits is grounded to prevent floating the common of the key. CI and C2 shunt any rf to ground. Shielded lead should be used to minimize rf pickup. The battery drain is 30 mA key up and 50 mA key down. A 9 and power obtained from transmitter or receiver B+.

volt zener may be substituted for the battery

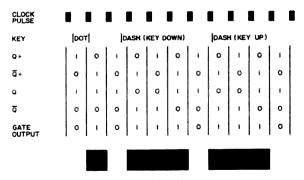


Fig. 2. Logic diagram of the keyer.

Edison—The Fabulous Drone

Was Edison really the great genius schoolbooks tell us he was? Or was he simply very diligent and hardworking?

The Great Man confided that he tried 'everything' while working on inventions. When 10,000 experiments with a storage battery went down to failure, he said: "I have not failed. I have just found 10,000 ways that won't work."

He argued with Nikola Tesla, the brilliant Serbian engineer and scientist, telling him that AC electricity was a "waste of effort and money".

"Looks like a bunch of Chinese laundry markings," he remarked of his hired mathematicians' worksheets.

He said: "Genius is one per cent inspiration and 99 per cent perspiration."

Most people think Thomas Alva Edison was perhaps the world's greatest inventor. But in comparison to his contemporaries, he was an inveterate fiddler, who scorned abstract work to tinker about with one failure after another.

Tesla observed Edison work methods thus: "If Edison had a needle to find in a hay-stack, he would proceed at once with the diligence of the bee to examine straw after straw until he found the object of his search." Tesla said further: "I was a sorry witness of such doings, knowing that a little theory and calculation would have saved him ninety per cent of his labour."

Edison plodded along, content to improve on existing ideas, insistent on hand work over brain work, and often completely blind to the uses of his own great and original work. Of his first phonograph, he said: "Maybe we could use it for some sort of telephone repeater."

In later years he said of its first successful test: "I was never so taken aback in all my life. Everybody was astonished. I was always afraid of things that worked the first time."

Even after patent rights were issued to manufacturers, Edison claimed it was "just a fad, and would be completely forgotten in five years". As late as 1925 he would not concede that electronic phonographs were superior and maintained that T. A. Edison, Inc. would make an improved mechanical phonograph for long playing records. Also in 1925 he noted that the 'radio

Also in 1925 he noted that the 'radio craze' would soon pass. "The present radio . . . is certainly a lemon. It will in time cure the dealer of any desire to handle any kind of radio." He also insisted that the public would not stand still for having to listen to the programming the broadcasters provided.

In 1926, though very hard of hearing, Edison tested an electronic phonograph perfected by Bertil Hauffman, a Swedish engineer, at the Edison Laboratory. Edison found the reproduction 'distorted and terrible' and ordered that Hauffman be fired. Son Theodore, director of the works, arranged for Hauffman to work hence in a part of the laboratory that Edison was not likely to visit.

Edison once said that he enjoyed his deaf-

ness because it permitted him to concentrate. Though his progressive deafness made him almost stone deaf in elder years, one wonders if the affliction also allowed him to ignore criticism in earlier times.

Another facet of the Edison myth is the famous story of his sleeping only four hours a night. John J. O'Neill reports in his biography of Tesla: "It was a regular practice with Edison to sit down in his laboratory and doze off into a three-hour nap about twice a day."

Edison was strangely adverse to theoretical work himself; as a thinker, he was second rate—as an administrator, second to none. The 'Wizard of Menlo Park' hired batteries of mathematicians and physicists, laughed at their theoretical approach, but utilised their results.

When the young genius Nikola Tesla came to this country, he had a letter of introduction to Thomas Edison, four cents in his pockets, and the key to alternating current electricity—today's housepower—locked in his mind. Edison offered him a meagre eighteen dollars a week, providing he never spoke of AC.

Tesla proved himself an able engineer and inventor, regularly submitting improvements for Edison equipment. When Tesla suggested research toward improved dynamo manufacture, Edison told him: "There's fifty thousand dollars for you in it—if it works." Inside the week, Tesla presented the design. When he finally had to ask about the money, Edison grinned and said: "I guess you just don't understand our Yankee humor."

Tesla quit. Some months later, he had interested investors in his ideas for AC, constructed working models, and applied for a patent. The U.S. Patent Office responded that the ideas contained in the original patent application were so far-reaching that no less than forty would cover them!

George Westinghouse, industrialist and inventor himself, offered Tesla one million dollars for the rights and the Westinghouse Electric Company was formed. This was prologue to the biggest battle of the 19th century: a technological war in which Thomas Alva Edison was the prime antagonist.

Edison had recently spent \$2 million with his DC system in New York City. The financial threat posed by Westinghouse and Tesla could not be ignored. Although Edison had said AC was "a waste of effort and money", he found his system impractical to produce voltages higher than 220, as the dynamo commutators heated badly. Too, line losses necessitated either large, expensive conductors or power stations spaced every mile or so.

DC power left the generating plant at about 120 volts; the users closest to the plant had the brightest lights, sometimes so much so that bulbs burned out frequently. Perversely, those at the end of the line had light hardly better than candlepower, because of the voltage drop along the line. With Tesla's AC system, alternating current could be transmitted equally to home or factory, with negligible power loss in the lines.

Edison wrote: "Just as certain as death Westinghouse will kill a customer within six months after he puts in a system of any size . . . it will never be free from danger."

Westinghouse argued that of thirty deaths by electricity in 'recent' years, sixteen were from 'safe' DC circuits, and none from Westinghouse equipment. During one period Edison lost about a workman a month with safe direct current and almost burned down the fashionable Vanderbilt home on Fifth Ave. A fire started when metallic-threaded draperies shorted out the wiring which had been placed behind it. Mrs. Vanderbilt returned home to find a confusion of firemen, assistants and Edison himself. Learning that there was a generating plant in her cellar, she became 'hysterical' and declared she could not live over a boiler. "We had to take the whole thing out," Edison ruefully remarked.

To sway public opinion in the "battle of the currents", Edison and Charles Batchellor -ironically the man who gave Tesla the letter of introduction to Edison-demonstrated the horrible dangers of alternating currents by electrocuting cats and dogs, using a one kilovolt generator. They paid eager schoolboys twenty-five cents a head for all the animals they could deliver. It is said that the house pet population around West Orange stood in danger of being annihilated. During one of these edifying illustrations for guests, Batchellor lost his hold on the dog he was about to electrify and himself received the shock. As he put it later: "The sensation was of an immense rough file thrust through the quivering fibers of the body."

After this, Edison published an article saying in part: "I have not failed to seek practical demonstration . . . I have taken life—not human life—in the belief that the end justifies the means." Yet in the final battle of this strange war, Edison seemingly reversed his opinions and requested permission to install AC equipment in upstate New York. Westinghouse hastily agreed.

It might be said that the news of the installation came as a shock to Westinghouse—it was the first electric chair. The New York State Legislature had adopted a statute in 1888 to provide for capital punishment by electrocution. H. P. Brown, a former research expert for Edison, supervised the installation of the 'hot squat' for the Edison General Electric Company.

On August 6, 1890, convicted murderer William Kemmler was to be executed. The first attempt at death by legal electrocution was a failure, as the electric force was too weak. The unfortunate man was led away. After quick modification to the chair, "the miserable work was perforce done again, resulting in a spectacle much worse than hanging."

A frantic Westinghouse recouped by obtaining the contract to provide power for the Columbian Exposition of 1893. Tesla had his own exhibit there, where he mystified fairgoers with his scientific marvels. The climax of the many performances was the passing of one million volts of AC through his body to melt a copper plate. It was not high voltage that killed, he maintained, but the destructive heating effect of high currents. High amperage DC could and did kill as readily as AC. While working up his demonstrations, he discovered the medical principle of diathermy.

The public was won over to AC and in 1895, Tesla harnessed Niagara Falls. His powerhouse was completed, providing AC for Buffalo, twenty-two miles away. It was hailed as the greatest engineering achievement in the world to that date.

In 1896, a mysterious cigar-shaped air-ship was seen by hundreds of people over San Francisco Bay, and subsequently was reported in successive eastward sightings. A New York *Herald* reporter obtained this statement from Edison, who disclaimed any knowledge of the never-identified craft: "I perfer to devote my time to objects of commercial value. At best airships would only

be toys." A few years later, he was congratulating Alberto Santos-Dumont for inventing powered flight, not recognising the achievement of the Wright brothers.

The Edison Effect—the expulsion of particles from a heated filament—grew from experiments with the light bulb. Edison found that bulb life was shortened by the deposit of carbon from the filament. He sketched in his notebook the first two-element vacuum tube as a solution to the problem, having found that current would flow into the second element. This forerunner of today's diode was patented but never used, and the patent lapsed.

With the diode, his discovery of the 'etheric force' and a subsequent patent of wireless transmission based on electrostatic induction, he had in his grasp the elements of a complete radio system several years before Hertz demontrated the existence of radio waves. Later in life, he said that it was a pity he had not seen any connection between them.

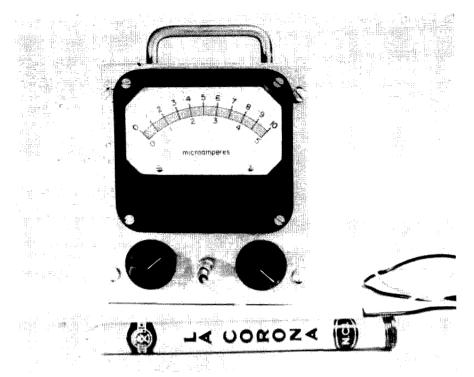
His first major invention, the carbon but ton microphone, is virtually the same today; it was a symbol of much of his work, since it improved an existing idea, the Bell device. Edison came, as it were, into a technological vacuum, purifying existing and imperfect concepts, and applying much of the random electrical science accumulated over fifty years. He did enough that he could well say in later years his productivity brought him "awards by the quart". He patented over 1,100 inventions and gained a vast reputation while his more brilliant and less understood contemporaries are all but forgotten.

George Westinghouse himself patented over 400 inventions in his lifetime and founded 60 companies.

Charles Proteus Steinmetz, whom Edison liked "because he never spoke of mathematics to me", published the law of hysteresis when he was only 27, went on to produce artificial lightning and delve into higher mysteries. He is little known today.

Nikola Tesla, besides giving the world AC, demonstrated radio control before the turn of the century, developed a working system of broadcast power, lighted his laboratories with wireless fluorescent lights in 1889, and had over 700 patents to his credit when he died in 1943. Yet he is the forgotten man of electrical science.

Edison, the Great Man, reigns supreme. . . . Elkhorne



Photos by Jim Harvey, WASIAK.

Jim Fisk WIDTY RFD I, Box 138 Rindge, N.H. 03461

A Sensitive RF Voltmeter

One of the handiest test instruments around the ham shack is the rf probe or rf voltmeter. This almost indispensible unit may be used for neutralizing transmitters, tuning up oscillators and in many other general tasks around the shop. Most hams simply purchase an rf probe to go along with their VTVM, but these probes are usually limited to an upper frequency range of somewhere around 250 MHz. Another serious limitation of the familiar VTVM rf probe is that the lowest voltage range on the VTVM is typically 1.5 volts. Some of the latest models have voltage ranges down to 0.5 volts tull scale, but the vast majority are not that

sensitive. When working with transistor rf stages, the millivolts (thousandths of a volt) become very important, and a more sensitive rf voltmeter than the common household VTVM must be used.

There are several approaches to this problem, but most of them are not very simple. The commercial instruments that read one millivolt full scale or less are quite complicated; they rectify the rf, chop it up at 1000 Hz, feed it into a very high gain, narrow passband ac amplifier, rectify it at the higher level and drive a meter movement. This is a very effect approach, but instruments using it cost upwards of \$500. The rf

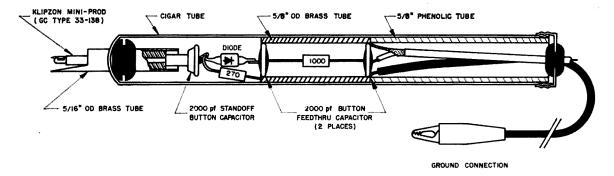


Fig. 1. Cutaway view of the sensitive rf probe. Note that the cigar tube construction results in an essentially coaxial structure; this type of construction ensures relatively flat response up to 500 MHz.

voltmeter I will describe here is not nearly sensitive enough to read 1 millivolt full scale, but with care in construction, you can readily detect 30 or 40 millivolt signals at 500 MHz. This is about 15 times more sensitive than the most sensitive VTVM and about 50 times more sensitive than the average one. Higher sensitivities are obtainable, but noise becomes the limiting factor with the simple construction described here.

With this rf probe, response is relatively flat from about 50 MHz all the way up to 500 MHz. The secret to this unit's wide frequency range lies almost exclusively with its layout and construction. First of all, the probe itself is essentially coaxial in nature, with the filter components mounted in a brass tube. To maintain leakage at an absolute minimum and to minimize series inductance, button mica capacitors are used in conjunction with a coaxial input. The result is a probe that will quite accurately measure small levels of rf voltage up to about 500 MHz. Above 500 MHz you can still get meter deflections with small rf voltages, but the response gradually falls off. This frequency roll off is a result of the parasitic and leakage elements that start to take effect at these higher frequencies. Above 500 MHz for example, it is difficult to predict the dielectric characteristics of molded carbon resistors. In some cases there is sufficient leakage between the two leads of the resistor to completely nullify the resistance.

In addition to the compact and coaxial nature of this probe, the low value of load resistance, 270 ohms, tends to maintain an input-output characteristic which is almost completely independent of frequency from several MHz up to 500 MHz. With the component values shown in the schematic, the

response gradually falls off below 50 MHz; at the expense of flat UHF response, the capacitors may be increased for response in the 3 to 30 MHz region. For the high frequency range the input coupling capacitor should have a value of about 500 pF and the filter capacitors should be 2000 pF. For lower frequency use of course, it is not necessary to maintain the coaxial structure of the probe nor to use the more costly button capacitors.

The selection of a diode depends on the frequency range desired. Up to about 100 MHz, almost any germanium diode will work quite well; the 1N34A is an excellent choice for this range. For higher frequencies however, many diodes are constructed in such as way that they exhibit high values of series inductance and leakage capacitance. For this reason, the familiar 1N21 and 1N23 microwave mixer diodes represent excellent choices for a voltmeter of this type which is designed for VIIF use. The 1N82A is another diode that works quite well up to 1000 MHz or so. Each of these diodes exhibits different characteristics and even diodes of the same type are not exactly identical.

It is a pretty well known fact that all semiconductor diodes exhibit a square law

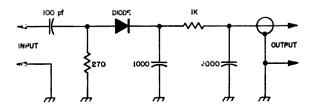


Fig. 2. The sensitive rf probe. For UHF use the expacitors should all be button types to minimize series inductance; for the lower frequencies, conventional types will suffice.

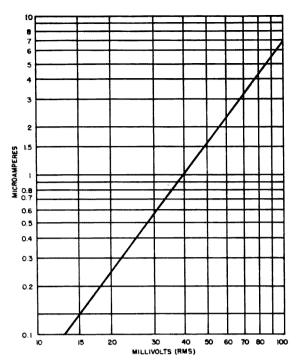


Fig. 3. The microampere per volt characteristic of a IN34A diode in the square law region. Above 100 millivolts or so, this curve becomes linear.

input-output characteristic up to several hundred millivolts. With germanium diodes the square law region is from zero to about 100 or 200 millivolts; silicon diodes are slightly higher, to 600 or 700 millivolts. The 1N34A diode for example exhibits a sensitivity of 700 to 1200 microamperes per volt squared in this region; a typical 1N34A μ A/V curve is plotted in Fig. 3. It should be pointed out that this curve varies with temperature, the amount again depending upon the individual diode used. However, in amateur applications this is usually not a problem because the probe will normally be used at room temperature. Above the square law region the sensitivity of semiconductor diodes is essentially linear and typically on the order of 5 milliamperes per volt.

Because of the large variance between diodes, the rf probe must be calibrated against a known source for maximum accuracy. Because of the construction of this probe, the calibration sounds much more complicated that it actually is. Since the probe is essentially flat up to 500 MHz, it may be calibrated at 100 MHz or so; most VTVM's are accurate enough at this frequency for calibration purposes. All you have to do is set the output of your signal

generator for 1 volt on the VTVM. For best results your generator should be operating on a fundamental and relatively free of harmonics. Since 1 volt is within the linear range of the diode in the VTVM rf probe, it should be reasonably accurate. Now all you have to do is connect an attenuator between the one volt source. You can breadboard an attenuator circuit for this purpose, or use a switchable attenuator such as that described by WB6AIG and WA6RDZ1. When the input-output characteristics are plotted on graph paper, you should end up with something like the curve of Fig. 3.

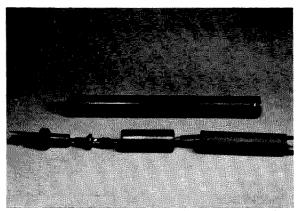
Construction of the probe is quite simple and is based upon the use of an aluminum cigar tube, the kind those 50c cigars come in. If you can't get one of these or don't smoke, an old pen light or piece of aluminum tubing will work with a little modification. The tip of the probe is made up from a Klipzon Mini-prod (General Cement 33-138) and a piece of 16 inch brass tubing from the hobby shop. This tubing is popular with slot car enthusiasts, so it shouldn't pose any procurement problems. One end of the mini-prod has a sharp tip with a small clip that may be clipped unto wires; the other end accepts a pin plug.

Apply a little epoxy cement to the miniprod and push it into the brass tubing. The mini-prod fits snugly in the tuning and is held firmly in place by the cement. Now place a 1/16 rubber gromment around the tube and push it about half way down;

cement it in place with epoxy.

While the epoxy is setting, take a 100 pF standoff button mica capacitor and solder it to a pin jack; this will eventually fit into the end of the mini-prod when the probe is complete. Cut a piece of % inch brass tubing about an inch and a half long and solder two button capacitors and a 1000 ohm resistor inside as shown in Fig. 1. This "filter" assembly should slide easily into the cigar tube. Also drill a 1/16 inch hole in the end of the cigar tube for the mini-prod assembly.

Install the diode and a 270 ohm resistor as shown in Fig. 1, using the very shortest leads possible. The cathode of the diode goes to the center pin on C2; the 270 ohm resistor is soldered to the brass tube. On the other end of the tube connect a length of cable; this lead will be connected to the microammeter. Install the complete assembly (miniprod, CI, CRI, RI and the filter) into the



Disassembled rf probe. The Klipzon Mini-prod is on the left, the button coupling capacitor, diode and 270 ohm resistor to the right, followed by the filter and phenolic tube. The cigar tube housing is in the background.

cigar tube and cut a length of % inch phenolic tubing so that it protrudes about ¼ inch from the end of the cigar tube. When the cover is in place this tube will compress the unit together and ensure a physically strong assembly. The shielded lead is brought out through a small rubber grommet mounted in the cover.

In addition to the rf probe, you will need a very sensitive microammeter for measuring small levels of rf. Occasionally 10 or 20 microampere movements are available at bargain basement prices, but usually another approach is necessary; the sensitive microammeter illustrated in Fig. 4 is a good example. This meter uses a high gain transistor meter amplifier to obtain full scale

readings down to 10 microamperes full scale on a 1 milliampere meter. With a full scale calibration of 10 microamps, it is quite easy to read a half microamp or so; this corresponds to 28 millivolts peak to peak with my probe.

The sensitive microammeter illustrated schematically in Fig. 4 consists of a current amplifier with the 1 mA meter in a bridge circuit². This circuit is quite stable with temperature and slight variations in supply voltage may be compensated by the zero control on the front panel. Almost any high gain transistor will work in this circuit, but silicon is preferred because of its better leakage characteristics. The only other requirement is that the transistor must maintain linear current gain and high beta at low collector current levels; the 2N3392 is inexpensive and works very well.

With the switch in the 10 microampere position, the 10k gain control is adjusted to provide 10 microamperes full scale. With a 1 milliampere movement, this corresponds to a current gain of 100. For full scale readings of 50 to 200 microamperes, meter shunts are proved for 5 and 20 mA full scale with the 1 mA movement; the transistor amplifier will maintain a current gain of 100. For meter readings of 1 milliampere, the transistor amplifier is disabled and the meter is operated in the normal manner. The value of the shunts may be calculated by using the formula found in any of the hand-books.

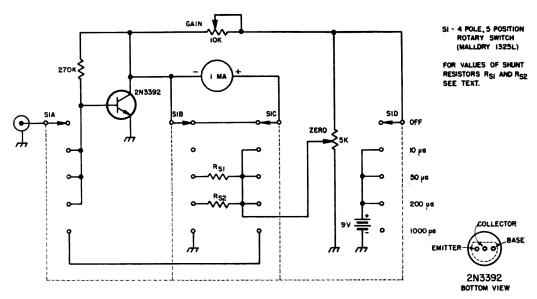


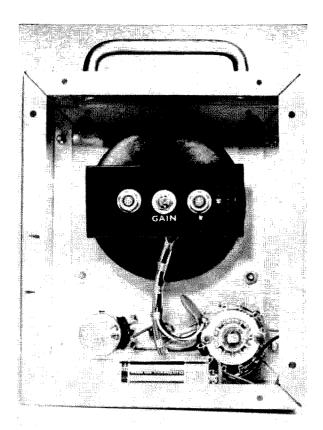
Fig. 4. Transistorized microammeter. This instrument will provide full scale readings down to 10 μ A. Although a 2N3392 was used here, any high gain silicon transistor that maintains high current gain at low collector current levels is suitable.

In my transistorized microammeter I mounted the transistor amplifier circuitry and meter shunts on a phenolic strip connected to the meter terminals. The gain potentiometer is also mounted on this strip. With a circuit as sensitive as this, noise can be a very serious problem if the circuit is not properly shielded. In this case a small coaxial cable was used in the input and the amplifier and meter were built into a metal box. In addition, the input was bypassed with a 0.01 µF disc capacitor.

With the sensitive microammeter and calibrated probe, it is quite easy to accurately measure rf voltage down to 30 or 40 millivolts. However, since this is a peak responding instrument, you have to be a little careful or you will obtain some very optimistic readings. If there is any harmonic content in the waveform you are reading, it is apt to be quite a bit higher than predicted, and the rms value will not be 0.707 of the peak reading; the 0.707 value applies only when the waveform is sinusoidal. This is not usually the case with rf oscillators and amplifiers, but if the harmonics are suppressed with high Q tuned circuits, the error will be negligible.

In addition to measuring actual rf voltages, this probe has several other uses. It may be used as a very sensitive untuned field strength meter by simply clipping a short length of wire to the tip; in some cases where the rf field is strong and the probe can be placed close enough to the transmitter, this may not be necessary. Hence another precaution: don't use the probe in strong rf fields when measuring small rf voltages; the rf field vill negate the voltage reading. This probe may also be used as a demodulator for a VHF sweep generator. Just connect the probe to the circuit being swept and connect the output to your oscilloscope. It may also be used to measure the SWR along a piece of open wire transmission line (or twin lead). When the probe is brought in close proximity to the transmission line, it will provide an upscale reading on the microammeter. The ratio between peaks and valleys as the probe is moved along the line is the voltage standing wave ratio.

In some measurements you may find that the probe will load down low-capacitance high-Q circuits. If you are only interested in peaking the circuit, and many times this is the case, this effect may be minimized



Inside of the meter amplifier. The transistor and gain calibration control are mounted on a piece of bakelite attached to the meter terminals. The rf probe disassembled. See Fig. 1.

by connecting a resistor in series with the probe. The Klipzon Mini-prod is ideal for this purpose because it will securely hold one lead of the resistor; the other lead may be used for probing. If a 5000 ohm resistor is used, it represents less than one pF coupling above 30 MHz; this should eliminate any detuning effect of the probe.

There are many other uses for the sensitive rf probe, limited primarily by the ingenuity of the user. But in it main application, that of measuring very small rf voltages, it is unbeatable for its expense and complexity. Although high rf voltages or mechanical shock may cause permanent damage to the diode, my probe has proven to be particularly resistant to burnout and has accepted peak surges of 500 Vdc and 120 Vac with no apparent effect on calibration. . . . W1DTY

^{1. &}quot;Low Power Attenuators for the Amateur Bands," WB6AIG and WA6RDZ, 73 Magazine, January 1967.

^{2. &}quot;Transistor Meter Amplifiers," WA6BSO, 73 Magazine, January 1966.

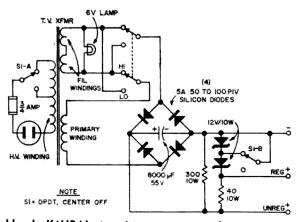
SDRAWKCAB Power Supply

Articles have already been written about building kW supplies with TV power transformers, using voltage doubling and series capacitors. The solid state man, shunning the lethal voltage approach to rf power generation, looks for a way to lower the line voltage. With this in mind, and with a junked TV in the shack, the supply shown here evolved. With 115 V in, the outputs are as follows:

Unregulated 16, 21, 32, 41 Volts Regulated 12, 24 Volts

The transformer is hooked up with the secondary connected to the line, and the primary as the input to a bridge and filter. Four levels of voltage are available at the unregulated output, which is the next best thing to owning a Variac. With a little more switchcraft, and with more filament windings, more levels can be had. The HV winding center tap provides a choice of high or low outputs, while the filament windings give series aiding or opposing differential adjustment at either level. Stud silicon diodes are used in the bridge. The .008 F capacitor is probably a little fat for the application, and a mere 4,000 µF would still guarantee a T9 report on the air.

The regulated outputs are at the 12 and 24 volt levels for this supply, but depending on your transformer, or your oscillator requirements, these could be modified to 9 and 18 volts, or even lower. For the loads presented by solid state receivers, the stud



Here's KIUBA's transistor power supply.

zener is an adequate regulator, so no series type regulation had been built in. On transmit, a voltage "droop" of over 25% has gone unnoticed on the air, as has a ripple considerably higher than the 0.1 V of this supply. Accordingly, no attempt has been made to regulate anything but the oscillator supply. If too much current is drawn from the unregulated output, however, regulation cannot be maintained.

Important criteria for selecting the transformer are:

- 1. The turns ratio
- 2. The internal resistance of the wind-
- 3. The number of filament windings. Transformers which give the highest voltage when normally connected are not necessarily what you want for this supply, since they may give too low an output when connected backwards. Also, their HV windings may exhibit high resistance which reduces the stiffness of the dc output. The author's supply has an internal resistance of 8 ohms. which limits maximum output to 53 watts. More filament windings mean greater range of differential adjustment.

The aluminum chassis acts as a heat sink for the bridge and zener diodes. All diodes are isolated from chassis ground with mica washers to allow a choice of positive or negative grounding. Threaded 6-32 stock holds down the capacitor, but it could have been epoxied to the chassis. The AC line switch is DPDT with center off position to minimize the number of controls, and it also cuts in the second zener when in the "HIGH" position. The pilot light is visibly dimmer in the "LOW" position, but it can still be seen. Grommets protect the transformer leads and the capacitor lugs.

On low voltage, a direct short will not blow the % Amp fuse, but component dissipations are within safe limits. The transformer is not operated anywhere near its allowable power limit for step-up operation, but it exhibits less than 10°C rise at full load, and should be adequate until the advent of the solid state kW.

. . . KIUBA

A Panadapter Converter

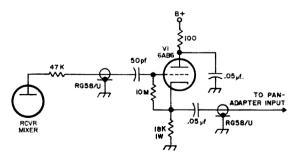
Having trouble getting those pretty pictures with your panadapter? Maybe you need an isolating amplifier.

I recently got a panadapter It worked fine with a signal generator, but gave pretty dismal results when I connected it to my receiver.

A careful search through the literature turned up all sorts of interesting notions on how to connect a panadapter to a receiver. Each was tried without success. Some loaded the mixer too much. Others attenuated the signal too much. Finally a reasonable presentation came on the screen, but only after reducing the length of RG-58/U connecting the adapter to the receiver to a ridiculous length that left the panadapter back to back with the receiver.

Something had to be done. A cathode follower was the obvious approach. One was installed as close as possible to the mixer stage. This gave a very high impedance to the mixer stage, but a low impedance into the coax running to the panadapter input. The results were excellent.

Since most receivers have an accessory socket on the back, this seemed to be an ideal way to get the B+ and filament voltage, and at the same time provide a mounting for the cathode follower circuit. The



A simple panadapter converter.

origonal unit was constructed in a Mini-box 15% x 21% x 234, using the piece that has the two ends on it for the chassis.

An octal plug is mounted on the long side. This not only makes the necessary electrical connections but also holds the assembly in place on the back of the receiver. The cathode follower circuit is assembled on one end, and an octal socket is mounted in the other end in case any additional accessory is to be connected to the receiver.

A 6AB4 tube was used because it was handy, but any of a number of other tubes might be substituted with only minor changes in the circuit. A more compact unit could probably be built easily by using a triode Nuvistor. Construction is straight-forward but lead lengths should be kept to a minimum, and the length of RG58/U between the mixer and the cathode follower should be kept as short as possible to minimize attenuation. The 47 k resistor should be as close to the plate connection as possible, and likewise the 50 pF capacitor as close to the 6AB4 grid as possible. The 100 ohm resistor in the plate circuit of the 6AB4 provides decoupling and was adequate in this installation, but a different value might be required in other installations.

Using this unit between the receiver and the panadapter, no detuning of the mixer is noted when connecting to it, and enough coax to allow the panadapter to be removed to a respectable distance from the receiver has little effect on the input signal. In fact despite the fact that the gain of a cathode follower is of necessity less than 1., the lowered impedance gives the effect of an actual gain.

... WB2CCM

73 Useful Transistor Circuits

Useful transistor circuits for audio and speech equipment, receivers, transmitters and test equipment.

Circuits for Audio Equipment

Direct coupled amplifiers

The direct coupled amplifier illustrated in Fig. 1 is just about as simple as possible, but provides very usable results. The collectors of the first two transistors operate at about 0.3 volts; this type of operation vields somewhat less than normal gain, but provides considerable reduction in noise produced at the input by the transistor. The biasing of the first stage is controlled by resistor R1 and because of the direct coupling between stages, indirectly controls the bias to the other two stages. Since the gain and leakage varies widely between different transistors, this resistor must be adjusted experimentally to provide optimum bias for the last transistor (Q3). This is easily done by adjusting its value until there is 0.8 volts across the headphones (points A and B in the schematic).

MIC VOLUME QI Q2 Q3 A PHONES (IKA DC) B

Fig. 1. Simple direct coupled amplifier. Transistors Q1, Q2 and Q3 should be the 2N207, 2N584, 2N1098, SK3003, GE-2 or HEP-254.

Since R1 is connected to the collector of Q3, bias variations caused by changes in temperature are reduced by negative dc feedback introduced by this resistor. For example, as the leakage in Q1 increases with temperature, the collector voltage on Q3 decreases. The increased leakage is partially compensated for because the lower voltage on Q3 causes less current to flow through R1. Generally speaking, this circuit will compensate quite nicely against temperature changes up to about 100°F. Above 100° it is possible that the transistor will be driven into nonlinear operation with resultant distortion and reduced power output.

The dc resistance of the headphones is very important in this circuit because the

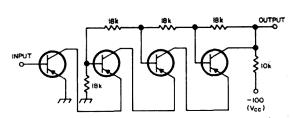


Fig. 2. High voltage direct coupled amplifier. The gain of this amplifier is equivalent to both sections of a I2AU7. All transistors are 2N384, SK3008, GE-9 or HEP-51.

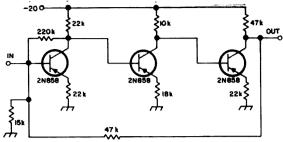


Fig. 3. This simple direct coupled amplifier provides 30 dB gain and identical 1500 ohm input and output impedances. For higher gain, similar units may be cascaded up until 10 volts peak to peak is obtained at the output.

voltage drop across them determines the operating conditions of all three stages. For optimum operation, the dc resistance of the earphones should be in the neighborhood of 1000 ohms. Most phones with an impedance of 2000 ohms have a dc resistance of 1000 ohms, but if you're in doubt, the resistance may be easily measured with an ohmmeter.

The main advantage of the high voltage direct coupled amplifier in Fig. 2 is that it may be connected directly to a rather high value of B+. Its gain is equivalent to a single 12AU7 (both sections) and because of the direct coupling, provides extremely wide bandwidth. Although the input impedance of this circuit is only 2000 ohms, it is still very useful for many applications where a simple amplifier is required.

Another very simple direct coupled amplifier is illustrated in Fig. 3. This amplifier provides almost exactly 30 dB gain and has identical 1500 ohm input and output impedances. For extremely high gain then, similar units can be cascaded up until an output voltage of 10 volts is obtained. This amplifier is also quite wideband, and with the transistors specified, the gain is essentially flat up to about 1 MHz.

Fig. 4. The gain of this wideband amplifier may be controlled by the value of the feedback resistor Rr. The 10K resistor shown here provides more than 30 dB gain from 10 Hz to 17 MHz. Q1 and Q2 are 2N2188, SK3006, GE-9 or HEP-2.

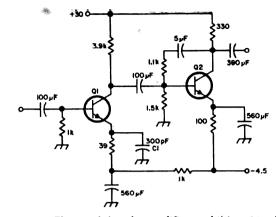


Fig. 5. This wideband amplifier exhibits 26 dB gain from 5 Hz to over 30 MHz and will deliver a 7 volt signal into a 100 ohm load. Transistors Q1 and Q2 are 2N2218.

Wideband amplifiers

In the wideband amplifier shown in Fig. 4, the gain is controlled by the feedback resistor Rr. With a 10 kilohm feedback resistor, the gain is greater than 30 dB from 10 Hz to 17 MHz. When the resistor is completely removed from the circuit, the gain is greater than 50 dB up to about MHz, but the biasing of the input transistor becomes very critical to prevent signal distortion. Note that the large electrolytic coupling capacitors should be paralleled with smaller capacitors that have good high frequency characteristics.

Another wideband amplifier is illustrated in Fig. 5; this amplifier has a frequency response from 5 Hz to over 30 MHz. The voltage gain over this range is 26 dB and the amplifier will deliver an undistorted 7 volt sine wave into a 100 ohm load. This circuit has excellent stability and linearity, and by adjusting the bias and emitter bypass capacitor C1 experimentally, the frequency response may be increased up to 50 MHz.

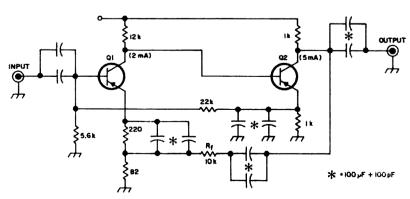
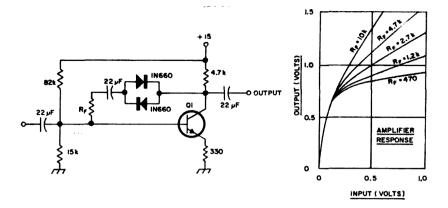


Fig. 6. The gain of this amplifier is controlled by the nonlinear feedback provided by two back to back diodes and the value of the feedback resistor R_f. Q1 is a 2N706, 2N708, 2N3394 or HEP-50.



Gain controlled amplifiers

It is a well known fact that the gain characteristics of an amplifier may be shaped by applying nonlinear feedback. In the amplifier of Fig. 6, the nonlinear feedback is furnished by two back to back diodes in the collector to base feedback path. Whenever the signal at the collector is high enough to forward bias the diodes (greater than approximately 0.6 volts peak to peak), negative feedback occurs and the gain of the amplifier is reduced. The gain of the stage may be further controlled by the value of the feedback resistor (Rr) as shown in the amplifier response curve. If it is desirable to have the nonlinearity occur at a higher level (greater than 0.6 volts peak to peak), more than one diode may be added to each leg of the feedback network. For lower levels, germanium diodes may be substituted for the silicon diodes specified in the schematic. With the germanium diodes in the feedback path, nonlinearity will occur when the signal is greater than about 0.1 volts peak to peak.

A voltage controlled, variable gain amplifier has many applications in automatic volume control, amplitude modulation and

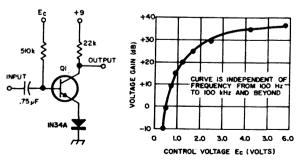


Fig. 7. Voltage controlled amplifier uses the varying impedance of a germanium diode in the emitter circuit to control gain. Transistor QI may be a 2N696, 2N3564, SK3019, GE-10 or HEP-54.

remote gain adjustment circuits. The only difference between the circuit shown in Fig. 7 and a standard common emitter amplifier is that a 1N34A diode is used in place of the emitter resistor. In an amplifier of this type, the gain of the stage is critically dependent upon the impedance of the emitter circuit. Since the impedance of the diode varies with the amount of current through it, the gain of the stage depends upon the transistor emitter current. The 1N34A was chosen because it provides an extremely wide impedance variation with a relatively gradual rate of change. This diode typically exhibits an impedance range from 15000 ohms at low levels to 200 ohms or less with high currents. The slow rate of impedance change is required to minimize distortion. This circuit is useful in ALC and AGC circuits, feedback regulation and other cases where wide dynamic range and instant response are required.

Preamplifiers

The simple low cost preamplifier in Fig. 8 provides extremely flat response from 10

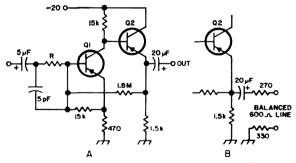


Fig. 8. High impedance preamplifier provides up to 1.2 megohms input impedance; the exact value depends upon the build-out resistor R. Both Q1 and Q2 should be a 2N2613, 2N2614, 2N2953, SK3004, GE-2 or HEP-254. A balanced output for reduced hum and noise may be obtained by using the padded output in B.

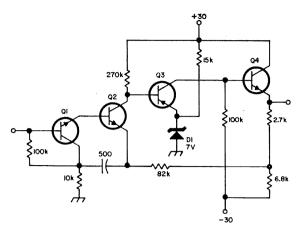


Fig. 9. This preamplifier provides II dB gain from 0.5 Hz to 2 MHz and has an input impedance of 32 megohms. Transistors QI, Q2 and Q4 are 2N338, SK3020, or HEP-53; Q3 is a 2N328, GE-2 or HEP-52.

Hz to 30 kHz and at the same time exhibits an input impedance up to 1.2 megohms. The input impedance of the first transistor with the unbypassed emitter resistor is on the order of 50,000 ohms; by including the build-out resistor R in the circuit, the input impedance may be increased up to 1.2 megohms. Without R in the circuit, the voltage gain is approximately 15. As the value of R is increased, the voltage gain decreases and the entire circuit exhibits unity gain when the value of R is 1.2 megohms.

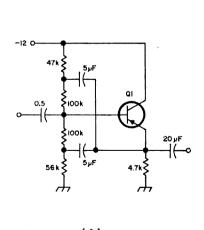
The output impedance of this simple preamplifier is particularly low, so it may be used for driving all types of circuits. Harmonic and intermodulation distortion are very low if 600 ohm circuits are connected across the output. It will also drive small 8 ohm speakers, but the distortion will be quite a bit higher.

The basic circuit provides an unbalanced output which should be suitable for most applications, but where hum and noise are a problem with balanced 600 ohm systems, the balanced output of Fig. 8B may be used. This pad adds a total of 6 dB loss in the output, but it does get rid of the hum and noise.

The four transistor preamplifier illustrated in Fig. 9 exhibits an input impedance of 32 megohms and provides 11 dB gain from 0.5 Hz to 2 kHz. The high input impedance of this amplifier is a function of the two negative feedback loops; one from the emitter of Q2 to the collector of Q1, the other from the junction of the 2.7k and 6.8k resistors in the emitter of Q4 to the emitter of Q2. The output impedance of this amplifier is 20 ohms so it may be used for driving many types of circuits.

In many cases an amplifier with an input impedance approaching that of a VTVM is required to keep circuit loading to a minimum. The amplifier of Fig. 10 more than meets these requirements; it provides up to 20 megohms input impedance, develops 1 volt rms across a 3300 ohm load and exhibits a frequency response from 10 Hz to 200 kHz.

The development of this circuit started



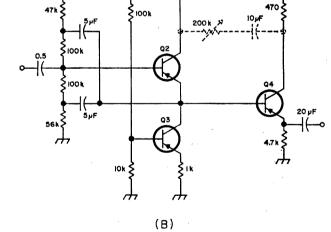


Fig. 10. This high impedance preamplifier provides up to 20 megohms input impedance and has a frequency response from 10 Hz to 200 kHz. Circuit B was developed from circuit A by replacing the emitter resistor in A with Q3 and adding an emitter follower to reduce loading. The input impedance is further increased by the components shown by the dashed line. All transistors are 2N2188, SK3005, GE-9 or HEP-2.

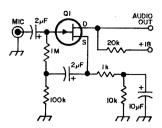


Fig. 11. Microphone amplifier using a field effect transistor has an input impedance of 5 megohms. Q1 is a 2N4360, TIM12, U-112 or U-110. By reversing the polarity of the supply voltage, a 2N3820, MPF-104 or HEP-801 may be used.

with the circuit shown in A. Here conventional bootstrapping was used on a basic emitter follower circuit to eliminate the shunting effect of the base bias resistors. When a transistor with a current gain of 100 was used, the input impedance was measured at 200K with a 3300 ohm load. A significant increase in input impedance may be obtained by replacing the emitter resistor of Q1 with the collector resistance of Q2 as shown in B. To keep the loading as light as possible on the emitter of Q1, an emitter follower (Q3) is used. With this circuit, the input impedance is slightly over 1 megohm with a 3300 ohm load.

The input impedance of this circuit may be further increased with the addition of the components shown by the dashed lines. However, if this positive feedback is overdone, the circuit will oscillate. If, on the other hand, the 200k feedback pot is carefully adjusted, the input impedance may be raised to 20 megohms or so before instability occurs.

The high impedance microphone pream-

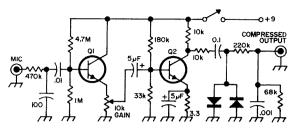


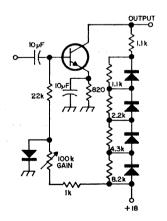
Fig. 12. Two stage clipper/preamp will increase the talk power of your rig. Transistors QI and Q2 are 2N1304, 2N2926, 2N3391, SK3011, or HEP 54. The diodes are IN456 or HEP-158.

plifier illustrated in Fig. 11 makes use of the inherently high input impedance of field effect transistors. This impedance is raised still higher by the use of the 2 µF bootstrap capacitor from source to gate; in this case to about 5 megohms. This circuit's output impedance of 2k is suitable for driving other FET's or conventional junction transistors.

Clipper/preamplifier

The microphone clipper/preamp shown in Fig. 12 is very simple to construct and allows you to stay as far away from the mike as you like; it does a very good job of beefing up weak audio signals. It was designed primarily for high impedance dynamic microphones, but may be used with other mikes with slightly less gain. It provides up to 10 dB gain on low level audio signals and since it uses a minimum of parts, may be easily constructed in a small minibox.

Although the best way to adjust a clipper such as this is with an oscilloscope the gain control may be set so that the final



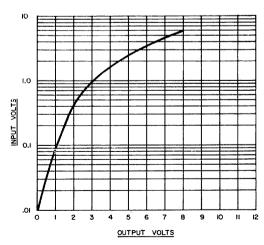
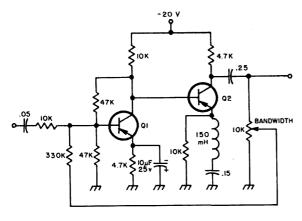


Fig. 13. This simple dynamic range compressor provides more than 50 dB range; it exhibits gain with a 20 millivolt signal but will not saturate with input voltages up to 6 or 7 volts. All the diodes are IN914; transistor QI should be a 2N2926, 2N3391, SK3010, GE-8 or HEP-54.



01, 02 - 2N465, 2N2953, SK3004

Fig. 14. This simple audio bandpass filter may be narrowed to the limits of unintelligibility. At a bandwidth of 80 Hz, it provides about 20 dB gain. The input is connected to the phone jack on your receiver while headphones are connected across the output.

audio stage (of your transmitter) approaches saturation on a steady whistle (into a dummy load please); this will approach optimum adjustment. A final check should be an on the air report from a nearby station so you can determine the approximate range settings appropriate for your particular transmitte.

Compression amplifier

The compession amplifier illustrated in Fig. 13 provides a minimum output signal with only 20 millivolts (0.02 volts) input,

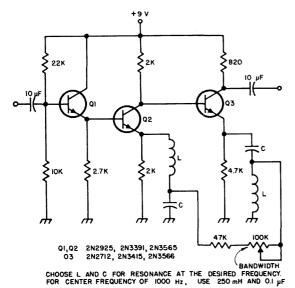


Fig. 15. This three stage audio filter uses two series resonant circuits to provide a very narrow audio passband. The Q of the circuits, and therefore the bandwidth, is controlled by the amount of feedback.

but will not saturate with input voltages up to 6 or 7 volts. The secret to its operation of course lays in the diodes connected across the collector load resistors. As the signal output is increased, the diodes conduct one by one and lower the resistance of the collector load. Although this amplifier has a minimum gain of 1 and a maximum gain of 15 with the components shown in the schematic, the gain characteristics may be made to follow other curves by the proper selection of load resistors and diodes.

Audio filters

The two transistor audio filter in Fig. 14 uses positive feedback to increase the Q of an inexpensive LC circuit to a very high degree. At a bandwidth of 80 Hz for example, this circuit provides 20 dB gain and furthermore, the bandwidth may be decreased to the limit of intelligibility. The gain stability is increased in this amplifier by the use of negative feedback from collector to base of Q1; this also serves to reduce the output impedance and increase the power transfer to the succeeding stage.

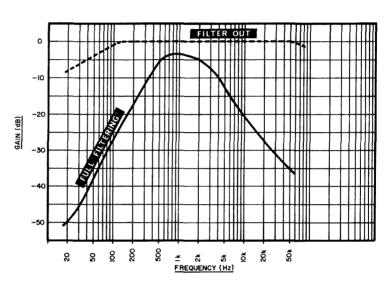
At frequencies far removed from the resonant LC circuit in the emitter of Q2, the emitter impedance is essentially that of the 10k emitter resistor. As resonance however, the low series impedance of the LC network predominates and increases the gain of the stage. Since the output signal is in phase with the input signal, the feedback through the 10k bandwidth pot and 330k resistor is regenerative. As the gain of the amplifier increases near resonance, the output voltage rises sharply and transforms the low Q circuit into a highly selective audio amplifier.

The proper value for the 330k feedback resistor varies from transistor to transistor, so the value of this resistor should be chosen experimentally. This resistor should just produce oscillation when the bandwidth pot is advanced to the maximum feedback position. To use this circuit, simply plug it into the phone jack on your receiver, connect a pair of headphones across the output and advance the bandwidth control until a whistle is heard; back off a little on the bandwidth and it's ready to operate.

The audio filter illustrated in Fig. 15 is somewhat similar to the one in Fig. 14 except that the passband has a better shape

22k OUT OUT OUT PU

Fig. 16. This highly versatile audio filter may be used to completely shape the audio spectrum of your receiver or transmitter; it may be used with the filters out, or with the variable low- and high-pass filter networks connected. All the transistors are low cost audio types such as the 2N1305, 2N1380, 2N2613, GE-2 or HEP-253.



factor because two series resonant LC circuits are used. Here again feedback is used to raise the Q of the resonant circuits to a very high value. The 47k resistor in the feedback line should be adjusted experimentally so that the circuit will just oscillate when the 100k bandwidth pot is shorted out (maximum clockwise position). Although the LC values shown in the schematic are for a center frequency of approximately 1000 Hz, other values may be used for

Fig. 17. Resistance-capacitance tone controls are usually not too satisfactory with junction transistors because of heavy loading. The high impedance characteristics of the FET eliminates this problem with no loss in the dynamic range of the tone control. Q1 is a 2N2943, 2N3820, MPF-105 or HEP-801.

other center frequencies.

One of the problems in amateur SSB communications is that the audio spectrum of the speech amplifier should be shaped so that it amplifies only those signals between about 300 and 3000 Hz. This can be accomplished by high-Q tuned circuits, but the inductors required are quite large and expensive. A simpler approach is to use the adjustable audio bandpass filter shown in Fig. 16. When the high- and low-pass filter of this amplifier are out of the circuit, it is flat within 1 dB from 100 Hz to 50 kHz. With the filters in the circuit, the audio may be shaped between the limits shown in Fig. 16.

Tone control

Audio tone controls using conventional junction transistors are difficult to build because the low input impedance of these devices seriously limits the tone control's dynamic range. An obvious solution to this problem lies in applying the inherently high input impedance of the field effect transistor. The tone control illustrated in Fig. 17 should be familiar to old vacuum tube hands; it is a straightforward tone control for both treble and bass using a modern FET in place of a thermionic triode.

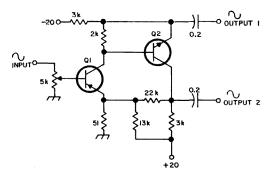


Fig. 18. This phase splitting circuit provides two out of phase signals for driving a push pull amplifier without an expensive transformer. The gain of the stage as shown is 150, but this may be adjusted by changing the value of the 22K feedback resistor. Q1 and Q2 are a complimentary pair such as the 2N652 and 2N388 or 2N2430 and 2N2706.

Phase splitter

The simple phase splitting circuit in Fig. 18 is a two stage direct coupled amplifier connected as a complementary pair with feedback and illustrates a novel way of obtaining out of phase driving signals for a push pull amplifier without an expensive transformer. The input transistor is a common emitter voltage amplifier with its collector tied directly to the base of Q2. The 3k resistor in the emitter of Q2 provides bias for this transistor but does not cause regeneration because it is common to both the base and emitter. The 13k resistor sets the overall circuit bias and its value is chosen so that the collector and emitter of Q2 are at the desired operating level. The 22k feedback resistor provides negative feed-

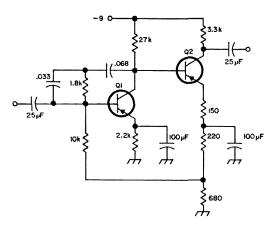


Fig. 19. This phono preamplifier uses frequency selective feedback between the collector and base of Q1 to obtain proper equalization during playback. Transistors Q1 and Q2 are 2N584, SK3003, GE-2 or HEP-254.

back to the emitter of Q1 and determines the gain of the circuit. In this case 22 kilohms was chosen to set the gain at 150, but other values of gain may be obtained by adjusting the value of this resistor.

Equalized audio amplifier

The equalized audio amplifier shown in Fig. 19 is a two stage direct coupled audio amplifier with a frequency selective feedback path. It is particularly suitable for boosting and equalizing the signal from a ceramic phono pickup to obtain a flat output of sufficient level to drive an audio power amplifier.

When playing a record, the output from the pickup is proportional to the force to which the stylus is subjected when tracing the groove. In fact, the open circuit voltage across the pickup is approximately proportional to the logarithm of the frequency with reference to the recorded amplitude. If the pickup is loaded with a very high impedance on the order of one or two megohms, the output versus input is nearly the inverse of the recording characteristic; therefore, the equalization is automatic.

However, it is not always possible to load the pickup with a very high impedance circuit, especially when transistors are used

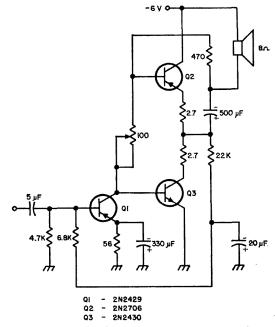


Fig. 20. This complimentary amplifier provides up to 220 mW output with a frequency response from 90 Hz to 12.5 kHz. Although matched transistors are not required for Q2 and Q3, they are available as the 2N2707.

in the preamplifier. Resistive pads may be used to increase the input impedance, but they greatly reduce stage gain and increase problems with signal to noise ratios.

In the amplifier of Fig. 19 equalization is obtained by a frequency selective feedback path between the collector and base of Q1. Stabilization at dc is provided by the direct coupling between Q1 and Q2 and the current feedback path through the 10 ohm resistor in the base of Q1. In addition, more negative feedback is provided by the unbypassed emitter resistor in the second stage.

Complementary power amplifiers

The small transformerless complementary amplifier illustrated in Fig. 20 provides an output of 220 mW with an input of only 40 microamps. The transistors in the single ended class B output stage are used in the common collector configuration and are biased by a resistive voltage divider and the driver transistor circuit. The emitter resistors in the output stage provide adequate temperature stability and are established by cut and try, but a value of 2.7 ohms seems to offer a good compromise. In adjusting this amplifier, the 100 ohm pot should be adjusted so that the idling current of the output transistor is on the order of 2.5 mA; this will insure a minimum of crossover distortion. When properly adjusted, this amplifier will exhibit a ±3

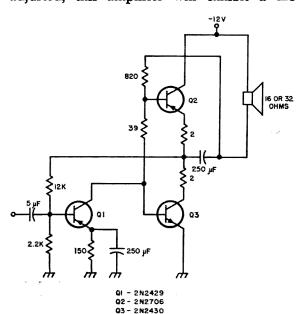


Fig. 21. This 470 mW complementary audio amplifier exhibits less than 2% distortion and is flat within 3 dB from 15 Hz to 130 kHz.

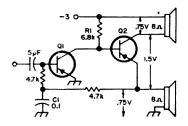


Fig. 22. An audio power amplifier with push pull output using a single transistor in the final stage may be obtained with this simple circuit. Only about 50 mW is available from this amplifier, but the gain is flat up to 30 kHz. Both Q1 and Q2 should be germanium audio transistors such as the 2N215, 2N404, 2N2953, SK3004 or HEP-253.

dB frequency response from 90 Hz to 12.5 kHz and distortion of 4% at 120 mW input and 10% at 220 mW input.

Another complementary audio amplifier is shown in Fig. 21. This power stage provides 470 mW output and utilizes both ac and dc feedback to minimize distortion and extend frequency response. Although unmatched transistors are not required for the proper operation of this amplifier, a set of matched transistors is available as the 2N2707; the cost of the matched pair is only several cents more than the total separate costs of a 2N2706 and 2N2430. This very useful amplifier is flat ±3 dB from 15 Hz to 130 kHz, exhibits an input impedance of 750 ohms and produces less than 2% distortion at 470 mW output.

Single transistor push pull

The amplifiers illustrated in Figs. 22 and 23 illustrate how a quasi-push-pull output may be taken from a single transistor.

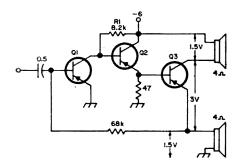


Fig. 23. A larger power version of the single transistor push pull circuit of Fig. 22 is shown here. The operating characteristics are similar to the 50mW circuit except that approximately I watt may be obtained. Transistors QI and Q2 are 2N215, 2N404, 2N2953, SK3004 or HEP-253; Q3 is a 2N554, 2N1032, 2N1666, SK3009 or HEP-232.

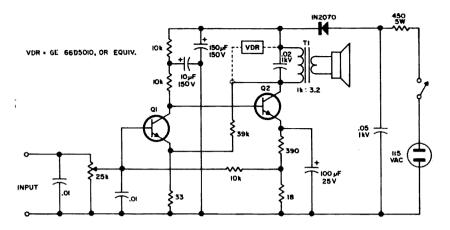


Fig. 24. This line operated audio power amplifier provides about 500 mW output with an 80 millivolt input signal. Q1 is a 2N3565, SE4002, SK3020 or HEP-54; Q2 is a 2N3916 or SE7005.

These amplifiers are dc connected, thereby eliminating many components, while at the same time assuring excellent low frequency response.

In the circuit in Fig. 22, the first transistor serves as both an ac driver and part of the dc bias system. Although the values shown in the schematic were selected for optimum results, the 6800 ohm biasing resistor (R1) should be adjusted experimentally to obtain equal voltages across the collector and emitter loads as illustrated in the schematic.

The frequency response of this amplifier may be adjusted by changing the value of the 0.05 µF capacitor (C1). When this capacitor is left completely out of the circuit, the heavy negative feedback around the circuit provides a frequency response that is flat from dc (with the input capacitor shorted) to 30 kHz. However, under these conditions, the gain is only about 35 dB. The maximum power output available from this circuit is on the order of 50 mW; above this level severe clipping occurs with noticeable audible distortion.

A higher power circuit that exhibits essentially the same characteristics is illustrated in Fig. 23. With properly heat sinked transistors, this unit provides usable outputs up to one watt. As with the lower power circuit, the bias resistor (R1) should be adjusted to provide equal voltages across the emitter and collector loads shown in the schematic.

The input impedance of both these circuits is on the order of several thousand ohms, so they may be easily driven by other transistor circuits. Although two separate speakers are shown as the output load, the load could just as easily be two separate transformer windings.

Line operated amplifiers

The line operated one watt amplifier in Fig. 24 provides about 500 mW output with an 80 mV input signal. The use of transistors with high collector to emitter voltage ratings permits the use of a transformerless power supply operating directly from the 115 volt ac line. To prevent damage to Q2 in the event of transient voltage spikes on the line, a voltage dependent resistor (VDR) such as a General Electric Thyrector or Motorola Thyristor should be connected across the primary of the output transformer.

Another line operated power amplifier is illustrated in Fig. 25. This amplifier is

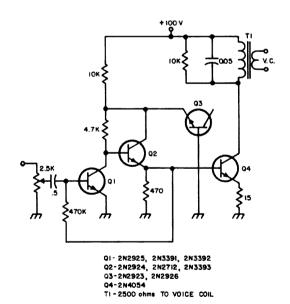


Fig. 25. High performance with low cost is obtained with this line operated audio power amplifier because expensive electrolytic capacitors are eliminated by direct coupling between stages. This circuit delivers I watt to the speaker with 3 mW input.

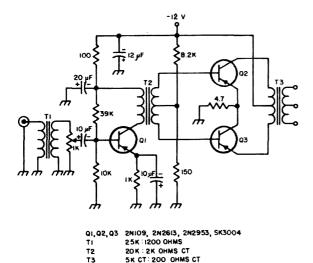


Fig. 26. This 100 mW modulator may be used to collector modulate transmitters up to about 200 mW or to base modulate somewhat larger power amplifiers. Good performance with a minimum of components is obtained by transformer coupling between stages.

based on the use of a high voltage plastic transistor, the 2N4054. The circuit delivers one watt of audio power to a speaker with about 3 millivolts input signal; at this power level the total harmonic distortion at 1 kHz is less than 10%. The key to its low cost performance is the fact that direct coupling is used, thereby eliminating the need for expensive electrolytic capacitors.

Modulators

The 100 milliwatt modulator illustrated in Fig. 26 is suitable for collector modulating small transistor transmitters up to about 200 milliwatts. It may also be used for base modulating somewhat larger transmit-

ters. The circuit is relatively straight forward, with a single audio amplifier driving the class B push pull power stage through a small transformer. To modulate the collector of a small transmitter, simply run the collector voltage supply through the secondary of the "moduation" transformer, in this case a low cost 5k:200 ohm audio transformer.

The 5 watt modulator shown in Fig. 27 may be used to modulate transmitters with up to 10 watts input. The use of low cost, high gain silicon transistors and efficient transformer coupling significantly decreases the complexity of the circuit. Usually many more transistors are required to obtain five watts of audio with a microphone input. Although this modulator was designed for a ceramic or crystal microphone, it may be used with dynamic types with slightly less gain. This circuit exhibits extremely low distortion characteristics, and when used to collector modulate a ten watt transistor transmitter, produces extremely clear and crisp audio.

The transistorized 25 watt modulator shown in Fig. 28 is not much different from other types which have been described, but with three transformers it is somewhat more efficient than most. The transformers are readily available commercial models which may be obtained from most suppliers. However, transformer T2 must have a center tap on the secondary; this is easily accomplished by unwinding 46 turns from the outside winding, bringing out a center tap at this point and rewinding. Impedance matching to the rf amplifier is accomplished by adjusting the rf output loading network.

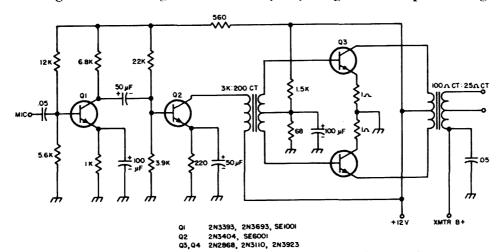


Fig. 27. 5 watt modulator for transmitters up to 10 watts input. High gain silicon transistors and transformer coupling increase performance at decreased circuit complexity.

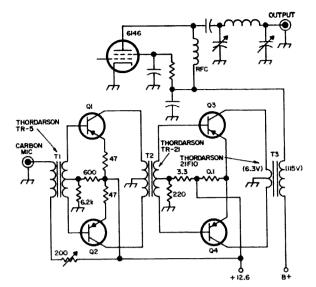


Fig. 28. 25 watt modulator uses readily available commercial transformers. Transistors Q1 and Q2 are 2N1172, 2N301, 2N1560, SK3009, GE-9 or HEP-232; Q3 and Q4 are 2N174, 2N278, SK3012, GE-4 or HEP-233.

The frequency response of this circuit is quite good and is essentially flat from 200 Hz to 7 kHz.

Circuits for Receivers

Injection oscillator

If you are interested in building a dual conversion receiver for single channel operation on MARS, 2 meter FM or WWV, the single oscillator circuit which provides two outputs illustrated in Fig. 29 should be of interest. This single oscillator circuit results in a reduction of components without sacrificing receiver performance. Basically it consists of a conventional common base transistor oscillator which provides the injection voltage for the second mixer. The output of the oscillator is fed into a diode harmonic generator and resonant tank which is tuned to the desired harmonic; this harmonic is used for injection into the first mixer. For example, for a dual conversion 15 MHz WWV receiver with a 455 kHz if, a 3636 kHz cystal would be used along with its third harmonic at 10.908 MHz. The 10.908 MHz signal would be mixed with the 15 MHz WWV signal in the first mixer to provide an output at 4092 MHz; this signal would in turn be mixed with the 3636 kHz oscillator output in the second

mixer to provide the 455 kHz if. The only consideration in choosing the crystal and harmonic frequencies is that only odd harmonics should be used. This is because when even harmonics are used in this scheme, poor second if image rejection will be a problem.

In most receivers the oscillator injection frequencies are below that of the signal frequencies. This is usually desirable since it results in a lower first *if* frequency which will provide better image rejection. In this case the necessary crystal frequency may be found from the following formula:

$$f_{\circ} = \frac{f_{\bullet} - f_{\circ f}}{h+1}$$

Where: f. = Crystal frequency

f. = Signal frequency

 $f_{ij} = if$ frequency

h = Harmonic to which diode tank circuit is tuned.

In those cases where it might be desirable to have the injection frequencies higher than the signal frequencies, the following formula may be used:

$$f_0 = \frac{f_0 - f_{if}}{h - 1}$$

BFO's

The simple BFO in Fig. 30 may be added to an existing receiver with a minimum of cost and effort. Essentially it is a tuned collector oscillator with an *if* transformer being used for the tuned circuit inductance. Just pick a transformer that is compatible with the *if* in your receiver; it doesn't make any difference to the transistor. Anything between 85 kHz and 1600 kHz will work

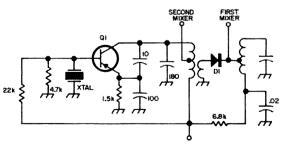


Fig. 29. Single oscillator and diode provide two injection frequencies for dual conversion receivers. Transistor QI is a 2N1745, 2N2188, TIM10, GE-9 or HEP-2; the diode should be a IN82A or similar.

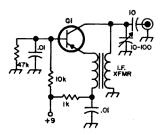
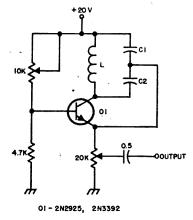


Fig. 30. This beat frequency oscillator may be added to existing receivers with a minimum of difficulty. The BFO frequency is determined by the if transformer which provides feedback from collector to emitter. Transistor QI should be a 2N384, 2N1749, 2N2362, TIMIO, SK3008, GE-9 or HEP-2.

well in this circuit. Before you can use the transformer though, remove all of the fixed tuning capacitors from the unit; usually these are readily available on the bottom of the transformer. If the circuit does not oscillate when voltage is applied, reverse the transformer leads going to the emitter of the transistor. To connect the BFO into the receiver, run a piece of small coaxial cable from the BFO output to the base (or grid) of the detector. In some cases sufficient injection will be obtained by just placing the coax lead in the immediate vicinity of the detector. Adjust the core in the BFO transformer so that the variable tuning capacitor allows the BFO output to swing to either side of the receiver if; then the variable capacitor will operate as a pitch control.



FREQUENCY	CI	C2	L
50 kHz	3500 pf	1500 pf	IO mH
80 kHz	2200 pf	910 pf	6.2 mH
100 kHz	1800 pf	750 pf	4.7 mH
200 kHz	910 pf	390 pf	2.2 mH
455 kHz	390 pf	160 pf	I mH
1000 kHz	180 pf	75 pf	0.47 mH

Fig.:-31. This simple circuit provides an extremely stable BFO. The frequency of oscillation may be tailered to your needs by simply choosing the proper tank components listed in the table.

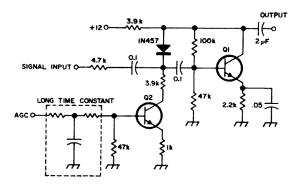


Fig. 32. This super AGC circuit only requires two transistors to obtain up to 60 dB of control. Q1 and Q2 are 2N1613 or HEP-254.

The circuit illustrated in Fig. 31 represents a temperature stable Colpitts oscillator which is very useful as a BFO. This oscillator utilizes an inexpensive silicon planar transistor and is exceptionally stable over wide ranges in temperature. In addition, it is characterized by a large output amplitude (10 volts peak to peak) and low harmonic distortion. In addition to duties as a beat frequency oscillator, this circuit is useful where a stable signal source is required up to several MHz. The 20k emitter pot is an output level control; the 10k pot in the base bias leg is used to adjust the base bias for maximum amplitude output.

AGC circuit

The super AGC circuit shown in Fig. 32 requires only two transistors to obtain 60 dB of control, while maintaining low distortion and power requirements. When a signal appears at the input with its corresponding AGC signal on the input of the long time constant circuit, Q1 conducts and causes current to flow through the diode. This current flow lowers the impedance of the diode and provides a low impedance path between the amplified signal at the collector of Q2 and the input signal at its base. When the diode conducts heavily, there is nearly 100% feedback and the gain of this stage is nearly unity. In addition, the input impedance of the stage becomes very low and results in a large voltage drop across the series connected 4700ohm resistor.

When the collector current of Q1 is reduced to zero, the feedback through the diode is negligible and the gain and input impedance of Q2 is the same as that of a standard common emitter amplifier. With

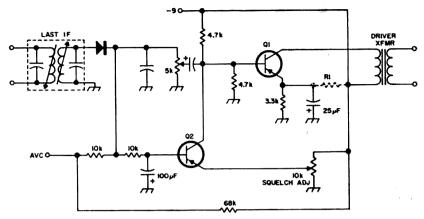


Fig. 33. This simple squelch circuit may be added to any transistorized receiver with only minor changes; in most receivers only four additional components are required, two resistors, a capacitor and a transistor. Q1 is an existing transistor in the receiver; Q2 is a 2N404, 2N2953, SK3004, GE-2 or HEP-254.

the constants shown in the schematic, a 60 dB control range is provided by a 0 to 100 μ A AGC input. To increase this range, high gain transistors and a higher voltage power supply must be used.

Squelch circuits

The simple, but positively acting squelch circuit in Fig. 33 may be added to any transistorized receiver with only minor changes in the audio section and four additional components. Without an input signal, normal forward bias to the *if* amplifier flows in the AGC line. A portion of this bias voltage is applied to the base of Q2 through the 10K ohm squelch adjust. This voltage biases Q2 into full conduction with the

squelch control pot determining the degree. When Q2 is saturated, base bias for Q1 is diverted to ground so the driver cannot amplify incoming noise and the speaker is quiet. When a carrier large enough to cut off Q2 is received, Q1 conducts and amplifies normally. The $100~\mu F$ filter capacitor in the base of Q2 removes all but the AGC signal coming from the detector.

To make the squelch less sensitive to large noise pulses, resistor R1 will ensure that transistor Q1 will be cut off until rf operates the squelch. The value of this resistor should be determined experimentally, since its value depends upon the type of transistor used in this stage.

Another simple squelch circuit is illustrated in Fig. 34. When there is no signal

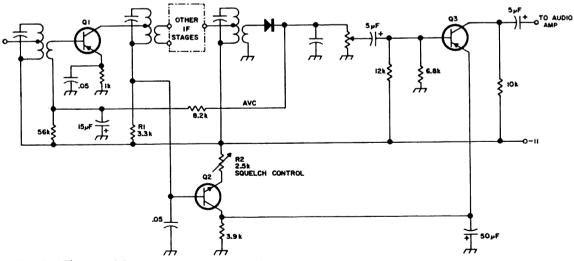


Fig. 34. This squelch circuit is very versatile and is capable of squelching out a 300 μ V signal and still maintain control down to less than 1 μ V. With the 2.5K pot set to squelch out a signal, approximately 3 dB increase in received signal will override the squelch. Q2 is a 2N1304, GE-5 or SK3011; Q3 is a 2N1274; GE-2 or HEP-254.

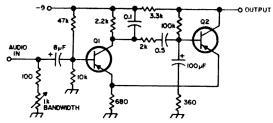


Fig. 35. This audio filter uses a 1000 Hz Wien bridge circuit to provide bandwidths from 70 to 600 Hz wide. Q1 and Q2 are 2N408, 2N2613, SK3004, GE-2 or HEP-254.

coming into the receiver, the AGC controlled *if* amplifier Q1 is operating at maximum gain. Under this condition the voltage drop across R1 is also maximum and is used to turn Q2 on. The current through Q2 is determined by the squelch control, R2. If R2 is set so that the current flow through Q3 causes the voltage drop across the 3.9k emitter resistor to be greater than the base voltage of Q3, it will be turned off. Under these conditions, there will be no output from Q3 and the receiver will be quiet.

When a signal is picked up by the receiver and the AGC is operating, the current through Q1 is reduced according to the signal strength of the received signal. This in turn reduces the voltage across R1, reduces the current through Q2 and lowers the voltage on the emitter of Q3. When the emitter to base junction of Q3 is forward

biased, the stage turns on and results in an output to the audio amplifier.

This circuit is very versatile and is capable of squelching out a 300 µV signal into the receiver and still maintain control down to less than 1 µV. In some cases there may be some audio distortion between the on and off conditions of Q3, depending upon the setting of the audio gain control. This distortion is not ordinarily objectionable however and when the signal is several times greater than that required to just trigger the squelch, it is not present.

Selective audio amplifier

Selective transistor amplifiers are very helpful in sorting out stations from the QRM that plagues our HF bands. They are also quite helpful in VHF and UHF work for effectively narrowing the bandwidth of the receiver. This is because as the bandwidth is narrowed, the noise in the receiving bandpass is reduced accordingly.

In the selective transistor amplifier illustrated in Fig. 35, the frequency selected is determined by a modified Wien bridge circuit in the collector of the first transistor. Although the constants shown in this circuit are for a center frequency of 1000 Hz, other frequencies may be selected by the proper choice of bridge components. The bandwidth of this circuit is determined

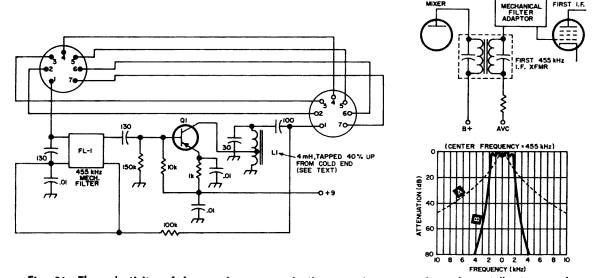


Fig. 36. The selectivity of inexpensive communications receivers may be substantially increased by the addition of this mechanical filter adapter. The transistor is used to make up for the 10 dB loss through the filter. The typical passband of a receiver without the filter is shown by A in the frequency response curve; the mechanical filter adapter results in curve B, QI should be a 2N1638, 2N1727, SK3008 or HEP-3.

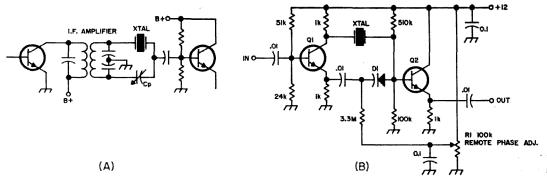


Fig. 37. Usually the crystal filter circuit in a receiver (A) must be physically located so the phasing capacitor (C_p) is accessible to the front panel. By using the varactor phased filter in B, the crystal may be located in any convenient location. Q1 and Q2 are 2N3478, 2N3564, 2N3707, 40236 or HEP-50; D1 is a 20 pF varactor such as the 1N954 or TRW V20.

by the value of the input load resistor, but with the resistors shown, it may be varied between 70 and 600 Hz.

Mechanical filter adapter

With the heavy ORM that is rampant on today's high frequency ham bands, the selectivity of many of the lower cost communications receivers leaves a great deal to be desired. In fact, in many cases the selectivity of these receivers is hopelessly inadequate. Adding a Q multiplier or a simple crystal filter will help to some extent, but these devices simply narrow the peak of the if response curve. Although this is quite suitable for CW work, it is of little help in separating SSB and AM stations. A much more useful improvement is the addition of a mechanical filter to the receiver if. Unlike simple LC circuits, the mechanical filter closely approximates the ideal bandpass response curve.

Wiring this filter into a receiver could require some pretty extensive rework, but by using the transistorized mechanical filter adapter illustated in Fig. 36, it may be simply plugged into the first if amplifier tube socket. The actual circuit itself is very straightforward; the simple transistor amplifier makes up for the 10 dB of loss through the mechanical filter. Coupling the output of the transistor to the grid of the first if tube is accomplished with the 4 mH coil. This may be made by winding 100 turns of number 36 on a cup core r toroid (tapped at 40 turns) or the primary of an inexpensive 455 kHz if transformer may be used.

Layout of the circuit is not at all critical except that care should be taken to make

sure that there is no leakage around the mechanical filter and amplifier. To this end the plate lead of the if tube should be shielded. Although the base layout shown in the schematic is for a 6BA6 tube, this adapter may be used with any if tube by simply placing the mechanical filter in the grid lead. Packaging this device is quite simple too; just mount an appropriate tube socket on top of a plug-in can (Vector G2.1-8-4), build the circuitry inside, plug it in the receiver tube socket and pick the weak signals out of the QRM.

Tunable crystal filter

One of the problems encountered when installing a crystal filter in a receiver for added selectivity is the fact that the unit must be installed physically close to the front panel so that the phasing control (C_p) is accessible. This problem is neatly solved by using the varactor tuned unit shown in Fig. 37. In this circuit, the crystal is phased by the varactor diode which may be remotely controlled by the variable resistor R1. The circuit may be used for any if from 100 kHz to 1500 kHz by simply selecting a crystal which is resonant at the desired frequency. In addition, the filter may be completely removed from the system by simply forward biasing the diode.

Cascode amplifiers

One of the big advantages of the cascode rf amplifier is that in the high frequency range it does not require neutralization. In the cascode circuit shown in Fig. 38, two transistors are connected so that the mismatch between them reduces internal

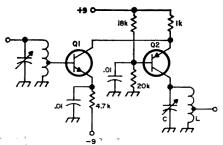


Fig. 38. This cascoda amplifier is extremely useful because it provides high gain without the need for neutralization. Q1 is a 2N918, 2N3464, 2N3478, MPS918, 40235 or HEP-56; Q2 is a 2N1742, 2N2398, 2N2894, 2N3399, TIM10 or HEP-2.

feedback; therefore the input and output impedance of the circuit is essentially independent of the source and load.

In single transistor amplifiers the collector to base capacitance causes internal negative feedback that reduces amplifier gain at high frequencies. This feedback also causes the input and output impedances of the transistor to be dependent upon the value of the source and load impedances. Normally this negative feedback is neutralized out with a small amount of positive feedback external to the transistor. Unfortunately however, this process is long and tedious and often requires many adjustments.

The isolation between several similar stages is particularly important where more than one stage is used, because as a multi-

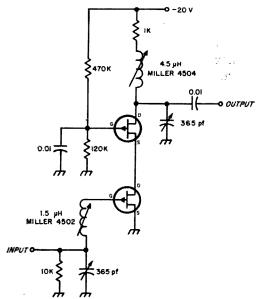


Fig. 39. This 30 MHz if stage uses two FET's connected in the cascode arrangement to provide 20 dB gain without neutralization; the bandwidth is 4 MHz. Both FET's in this circuit are 2N3819, MPF105 or TIS34. With a negative supply voltage, the 2N4360 or TIM12 would be suitable.

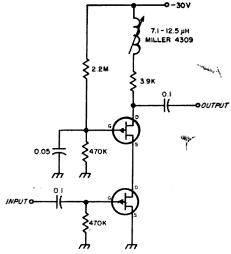


Fig. 40. This cascode video amplifier provides more than 6 MHz bandwidth with a voltage gain of 10. Both FET's are 2N3819, MPF105, TIS34 or HEP-801. A negative supply would permit the use of a 2N4360 or TIM12.

stage amplifier is being aligned, the tuning of one stage effects all the other stages. With the cascode rf amplifier, this shortcoming is overcome. Moreover, the gain of the cascode circuit is greater than the gain of a neutralized common-emitter stage with the same stability.

Since the emitter of Q1 is tied directly to the negative supply, the base can be connected directly to the output of the previous stage which is at ground potential. This eliminates a coupling capacitor and speeds up circuit recovery time after an overload. In addition, the gain of the stage may be controlled by varying the amount of current through Q1 (by adjusting the value of the negative supply).

The high gain cascode circuit shown in Fig. 38 uses two very inexpensive transistors to obtain 15 dB gain at 100 MHz with no neutralization; at lower frequencies the gain will be somewhat higher. No values are shown for the tuned circuits because they will be different for each application. However, dc biasing is usually the toughest part of any amateur transistor circuit design, and that is already done; all you have to do is put some tuned circuits in. The tap point on the input inductor should be chosen for best noise figure. The tap on the output inductor is chosen for maximum power gain.

Another somewhat different cascode circuit is illustrated in Fig. 39. This cascode 30 MHz if amplifier uses FET's and is

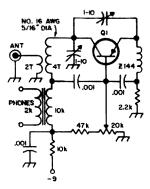


Fig. 41. This simple one transistor superregenerative receiver for two meters may be used for copying many local signals. With the components shown, this receiver will tune from about 90 to 150 MHz. It may be used on other frequencies by changing the inductor and capacitor as described in the text. Q1 is a 2N1742, 2N2398, 2N3399, TIM10, GE-9 or HEP-2.

characterized by a 20 dB power gain, bandwidth greater than 4 MHz, and all without the necessity for neutralization. For even more gain, these stages may be simply cascaded.

The cascode video amplifier shown in Fig. 40 is almost an exact replica of the vacuum tube circuit that was originally developed in the 1940's. Usually a single triode is avoided in wideband or video amplifiers because the input capacitance and its multiplication by device gain (called Miller effect) seriously loads the input capacitance is no longer multiplied by the gain of the device, but is limited to the input capacitance of the FET. With the shunt peaking

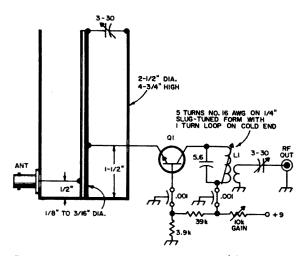


Fig. 42. Low noise two meter preamplifier uses a beer can cavity to provide excellent discriminatoin against nearby kilowatts. QI is a 2N3478, 2N356?. 2N3564, 40235 or SK3015

inductance shown (Miller 4309), this circuit is characterized by a voltage gain of 10 with a 3 dB bandwidth of over 6 MHz. The value of the inductance shown should work with most loads, but in some cases the bandwidth may be increased by changing its value slightly.

Two meter superregenerative receiver

The simple little receiver shown in Fig. 41 was designed primarily for the two meter band, but with appropriate changes in the input rf coils, it will work equally well on any frequency between 28 and 160 MHz. Basically, Q1 is a common base oscillating detector stage which quenches at about 25 kHz. The audio output from the detector is coupled across the transformer to the simple two stage audio amplifier. For more audio output, a 500 to 3.2 ohm transformer may be connected between Q3 and the speaker. The 20 kilohm pot should be adjusted for a total current drain of about 30 mA.

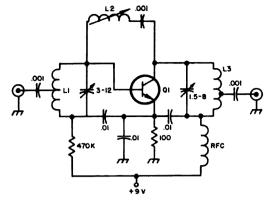
With the circuit constants shown in the diagram, this receiver will tune from about 90 to 150 MHz. To cover six meters, the tuning capacitor should be changed to a 15 pF unit and the number of turns on L2 increased to 6½. Since this is a regenerative receiver, it must be completely enclosed in a metal box to avoid the undesirable effects of hand capacity.

Two meter preamp

The two meter preamplifier of Fig. 42 uses inexpensive transistors in the common base configuration, yet provides noise figures that are nearly optimum for this band. The coaxial input cavity is easy to build and will provide more than adequate selectivity against your high powered neighbors on two. Although this input cavity may be built from scratch, the easiest approach is to use a spent beer can. Be careful when choosing the can though, some brewers are using aluminum cans wich are pretty difficult to solder. The whole amplifier may be mounted on a small piece of epoxy board and then the entire assembly attached to the outside of the cavity.

220 MHz rf amplifier

The 220 MHz rf amplifier shown in Fig. 43 exhibits about 17 dB gain, although the exact amount will depend upon the type of transistor used. Optimum operation for low-



- 3-1/2 TURNS NO 16, 1/4" DIAM, 1/2" LONG. TAPPED AT CENTER. 8-1/4 TURNS NO 24 ON 1/4" SLUG-TUNED FORM.
- 8 TURNS NO. 18, 1/8" DIAM, 7/8" LONG. TAPPED ONE TURN FROM COLO END.
- 2N3478, 2N3564, 40235
- RFC 0.84 µH (OHMITE Z-220)

Fig. 43. Low noise 220 MHz preamplifier. This circuit will provide extremely high gain with low noise on the $1\frac{1}{4}$ meter band. Neutralization is controlled by inductor L2.

est noise figure also depends upon the transistor type, but usually will be in the vicinity of 6 volts collector voltage and 1 mA collector current. Unfortunately, this is usually not the same operating condition for maximum gain; maximum gain will occur at somewhat larger values of collector voltage and current. When this amplifier is set up, the 470k base bias resistor should be adjusted for the condition that you are looking for, whether it be minimum noise figure, maximum gain or a compromise between the two. Remember that for most practical receivers the noise figure will be dictated by the noise figure of the first rf stage; more gain can be added by another stage of amplification.

Circuits for Transmitters

Crystal oscillators

A compact untuned crystal oscillator is a very useful unit to have around the shack. The oscillator illustrated in Fig. 44 does not have any tuned circuits, so almost any crystal from 300 kHz up to 10 MHz will oscillate satisfactorily. It can be used for driving transmitters, as a signal source or for just testing crystals. In this circuit the first transistor is operating as an untuned crystal oscillator with the second transistor

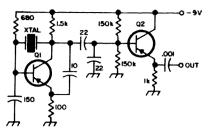


Fig. 44. This untuned crystal oscillator will oscillate with any crystal from 300 kHz to 10 MHz. Frequency stability is very good because the emitter follower buffer amplifier effectively isolates the oscillator from the load. Q1 and Q2 are 2N993, 2N1749, 2N2084, 2N2362, TIM10, GE-9, SK3006 or HEP-2.

connected as an emitter follower. With this arrangement, Q2 acts as a buffer stage and quite effectively isolates the oscillator from the load.

Another untuned crystal oscillator stage is shown in Fig. 45. This circuit will oscillate with any crystal between 3 and 20 MHz with no tuning whatsoever. If overtone crystals are plugged into the circuit, they will oscillate on their fundamental frequency. For overtone crystals up to about 60 MHz, the fundamental will be approximately 1/8 the marked frequency; above 60 MHz the fundamental is normally about 1/8 the marked frequency. For best stability with each of these untuned crystal oscillators, all the capacitors should be high grade silver mica types.

The crystal oscillator shown in Fig. 46 has proven to be extremely stable and easy to adjust. Basically it is a standard Colpitts circuit with the frequency determined by the crystal. By using the appropriate inductors and capacitors, this circuit will oscillate

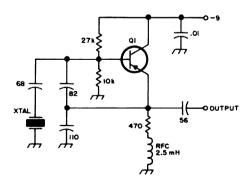
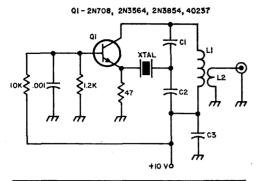


Fig. 45. This crystal oscillator will oscillate with any crystal between 3 and 20 MHz with no tuning whatsoever; overtone crystals will oscillate on their fundamental in this circuit. OI is a 2N1177, 2N1180, 2N1742, GE-9, SK3006 or HEP-2.



FREQUENCY	REQUENCY CI		C3	LI	MILLER NO.	L2
10 - 13.5 MHz 13.5- 18 MHz 18 - 24 MHz 23.5- 32 MHz 32 - 42 MHz 42 - 53 MHz 58 - 84 MHz	30pf 30pf 10pf 10pf 10pf	300 pf 300 pf 300 pf 100 pf 100 pf 100 pf	.01 .01 .01 .001	5.0 - 9.0 µH 2.8 - 5.0 µH 1.6 - 2.8 µH 2.8 - 5.0 µH 1.6 - 2.8 µH 1.0 - 1.6 µH 0.4 - 0.8 µH	4504 4503 4504	4-1/2T 3T 2-1/2T 3T 2-1/2T 2T 1-1/4T

Fig. 46. This Colpitts type crystal oscillator may be used with either fundamental or overtone crystals from 10 MHz to 84 MHz with the tuned circuit components listed. It oscillates quite readily when adjusted and provides a stable output.

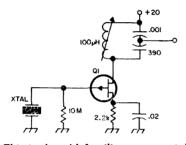


Fig. 47. This is the old familiar vacuum tube Pierce oscillator circuit with a field effect transistor in place of the thermionic triode. Circuit constants shown here are for the I MHz region, but the tuned circuit may be adjusted to any frequency desired. Q1 is a 2N4360 or TIM12.

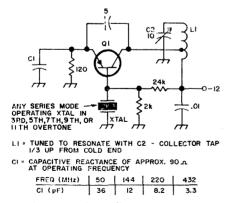


Fig. 48. This crystal oscillator was designed specifically for overtone crystals and will oscillate up to the 11th overtone in the VHF range. Suitable values for CI are shown for the VHF bands; for other frequencies, CI should exhibit approximately 90 ohms capacitive reactance for best results. QI is a TIM10, TI400 or HEP-3.

with either fundamental or overtone crystals. Although circuit values are only provided here up through 84 MHz, this circuit will operate well above 100 MHz with smaller values of capacitance; the only requirement is that they retain a 10 to 1 ratio in capacitance. For operation with a negative supply voltage, ground the 10 volt line shown in the schematic, lift the 1.2k and 47 ohm resistors from ground and tie them to the negative supply. PNP germanium transistors may also be used by reversing the supply voltage and changing the 10K base bias resistor to 33k.

The untuned crystal oscillator in Fig. 47 uses an FET in the familiar Pierce vacuum tube circuit. In this oscillator the drain to source capacitance and gate to source capacitance make up the feedback path with the amount of oscillator excitation determined by their ratio. This circuit cannot be used with conventional junction transistors because their low input impedance severely loads down the crystal.

The crystal oscillator shown in Fig. 48 is designed specifically for overtone crystals and will work up through the eleventh overtone. The circuit is completely noncritical except for the value of C1 which should exhibit approximately 90 ohms capacitive reactance at the operating frequency. The tuned circuit is tuned to the frequency of interest. The 5 pF capacitor from collector to emitter should be adjusted for maximum rf output; above about 200 MHz it may not be required. The constants shown in the schematic should cause oscillation with any overtone crystal in the VHF range, but in some cases a sluggish crystal may require adjustment of the 24k base bias resistor to take off every time power is applied.

Variable crystal oscillator

The variable crystal oscillator shown in Fig. 49 is a very useful circuit to the ham who wants a highly stable signal on two meters or 432. Although it will only tune about 50 kHz on two and 150 kHz on 432, it is adequate for many types of operation. On 432 for example, most operation is within a few kHz of 432.00 MHz. The circuit's operation is quite straight forward; the dual 365 pF capacitor pads down the resonant circuit and pulls the crystal down in frequency. Just how much it is pulled down is determined by the inductor L1. For an

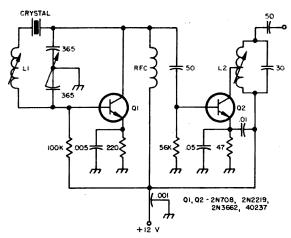


Fig. 49. This variable crystal oscillator (VXO) may be used to vary the frequency of an 8 MHz crystal 4 or 5 kHz when the 365 pF dual variable is tuned through its range. When multiplied to two meters or 432, this provides a very stable variable frequency. For 8 MHz crysals, LI is a 20-25 uH slug tuned coil; L2 is chosen to resonate at 8 MHz with the 30 pF capacitor.

	Table 1	
Crystal	L ₁	L ₂ *
3.5 MHz	35-60 μH Miller 45	509 80 turns #36 tapped at 27 turns
5.0 MHz	24-35 μH Miller 45	508 62 turns #36 tapped at 21 turns
8.0 MHz	16-24 μH Miller 45	507 40 turns #36, tapped at 13 turns
9.0 MHz	16-24 μH Miller 45	507 36 turns #36, tapped at 12 turns

^{*}Wound on ¼" slug tuned form.

8 MHz crystal, this inductor should have a center value of about 22 µH; it should exhibit relatively high Q at 8 MHz and be self resonant well above the crystal frequency. As this inductor is increased beyond a certain amount, the crystal will lose control and the circuit becomes a rather inferior VFO. For best results LI should be adjusted so that the crystal is pulled 4 or 5 kHz when the variable capacitor is tuned through its full range.

The buffer amplifier is coupled to the oscillator through a 50 pF capacitor. For maximum frequency stability, this capacitor should be the minimum value that will provide adequate drive for your transmitter. With the 50 pF capacitor shown, approximately 10 volts of 8 MHz drive should be available with the buffer tank tuned to resonance. Inductor L2 is chosen to resonate at 8 MHz with the 30 pF capacitor; the tap is ½ up from the ground end.

Two frequency crystal oscillator

In the two frequency crystal oscillator illustrated in Fig. 50, the bilateral characteristics of the transistor effectively provide two separate common emitter stages. Either of the two frequencies may be selected by simply applying a positive or negative voltage to the circuit.

When a positive voltage is applied, current flows through D1 to the emitter of the transistor. The tuned circuit consisting of L2, C2 and the crystal Y2 determine the oscillation frequency available at the output. The other tuned circuit consisting of L1 and C1 is shorted out by D1. In addition, since crystal Y1 is connected between the base and emitter, there is no gain to promote oscillation at its frequency.

If a negative voltage is applied to the supply terminal, the transistor "inverts" itself with the collector becoming the emitter and the emitter the collector. In this case L1, C1 and Y1 determine the frequency of oscillation. Diode D2 shorts out the other tuned circuit and the crystal Y2 is connected between the base and emitter of the inverted transistor; therefore, there is no output at Y2's frequency.

Transistors may not normally be used in the inverted mode because rather large

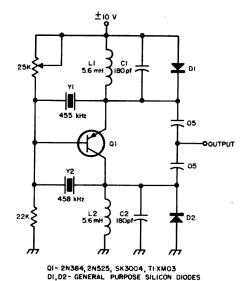


Fig. 50. This two frequency crystal oscillator changes frequency by simply reversing the supply voltage. When the supply voltage is changed, the transistor inverts itself; usually transistors may not be used in the inverted mode, but in an oscillator a gain of only 1 or 2 is needed and this circuit provides a novel and simple way of obtaining two frequencies from a single stage with a minimum of switching.

amounts of gain are desired. However, as an oscillator, the gain need only be sufficient to produce oscillation; this usually requires a forward current gain of only one or two. For this reason almost any germanium transistor may be used in this application. Silicon NPN transistors will also work, but operation will be just opposite to that described above.

Diodes D1 and D2 limit the output voltage to about 0.7 volts, so for some applications, further amplification may be necessary. The tuned circuit values shown in the schematic are for a resonant frequency of 455 kHz, where this circuit provides an excellent method for upper and lower sideband selection. It may be used on other frequencies by simply changing the values of inductance and capacitance in the tuned circuits.

UHF oscillator

The simple UHF oscillator circuit shown in Fig. 51 will deliver up to about 2 mW of power at 1000 MHz. Although this amount of power is insufficient for some applications, 2 mW is more than enough for many mixer and converter circuits. Many transistor types, when selected, will oscillate up to 1500 MHz in this simple circuit.

Ten meter transmitter

The three watt ten meter transmitter shown

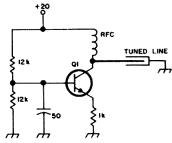


Fig. 51. This simple UHF oscillator will provide about 2 mW up to 1000 MHz; some selected transistors will provide usable power up to 1500 MHz or so. Q1 is a 2N918, 2N3478, 2N3564 or HEP-56.

in Fig. 52 gets over the high rf power/high price hurdle by using three inexpensive transistors in parallel in the final stage. The three paralleled transistors used will produce three watts output with a 15 to 18 volt supply and about 2.25 watts with a 12 volt supply. The rf drive is provided by a 28 MHz crystal oscillator and driver amplifier. For maximum efficiency, modulation is applied to both the final amplifier and driver through the modulation transformer; about 1.5 watts of audio power is required for 100% modulation. Since the transistors used in this transmitter have an fr of 500 MHz, a similar transmitter could be built for six meters; the only change would be in the resonant circuits.

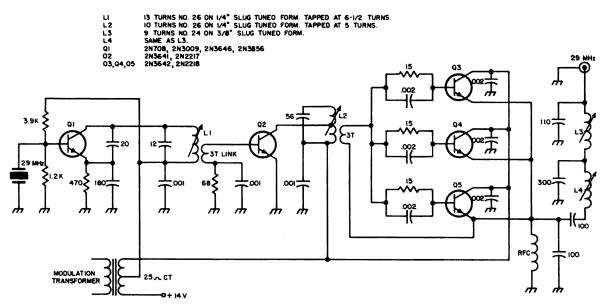


Fig. 52. This three watt ten meter transmitter maintains high efficiency and low cost by paralleling three inexpensive silicon transistors in the final stage.

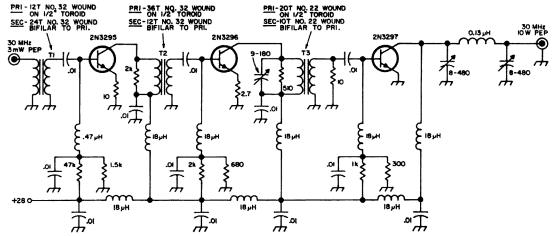


Fig. 53. This ten meter linear amplifier for SSB service uses transistors which were designed specifically for single sideband linear operation. Many junction transistors cannot be used satisfactorily for this application, because linear amplification at low power levels is a serious problem.

Ten meter linear amplifier

Up until the present time transistors haven't been used too much in SSB transmitters because linear amplification at even low signal levels has been a serious problem. However, the transistors in the ten meter SSB power amplifier illustrated in Fig. 53 were designed specifically for linear amplifier service and perform quite well. The measured distortion of these devices is less than three percent without feedback, which is somewhat better than tubes under the same conditions.

Actually the circuit of this amplifier is quite straight forward. The only critical parts are the coupling transformers between succeeding stages. These are wound on small ½" toroids which are suitable for use at 30 MHz (Ami-tron T-50-2). Coupling between stages must be very tight and the

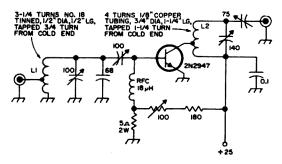


Fig. 54. This ten meter single sideband linear power amplifier will provide up to 8 watts PEP. The power gain of the 2N2947 is 13 dB at this frequency, and the odd order distortion products are at least 30 dB below the desired output.

transformers should be bifilar wound. Both the input and output of this unit are designed for 50 ohm coaxial line, so it fits in nicely with other equipment being used on ten meters.

The ten meter single sideband linear power amplifier shown in Fig. 54 is capable of delivering an output power of 8 watts PEP. The power gain at this frequency is 13 dB, and all odd-order distortion products are at least 30 dB below the desired output.

The main difference between this amplifier and one designed for class C operation in CW, AM or FM transmitters lies primarily in the dc bias circuit. For class C operation, the only dc bias normally applied is the collector supply voltage. The 18 µH rf choke and resistive divider in the base circuit would be omitted. The transistor is biased on by the driving signal on the base. This results in one of the big advantages of the transistor transmitter—if the driving signal is suddenly removed, the power amplifier merely shuts off and sustains no damage.

To obtain linear operation, a small amount of forward bias is applied to the transistor. This is a function of the resistive divider and the isolating choke in the base circuit. The bias is adjusted so that a small collector current flows without any input driving signal; when a driving signal is applied, the transistor is biased on to full operating collector current. In this circuit the 2N2947 draws 20 mA with no drive and 350 mA with full drive.

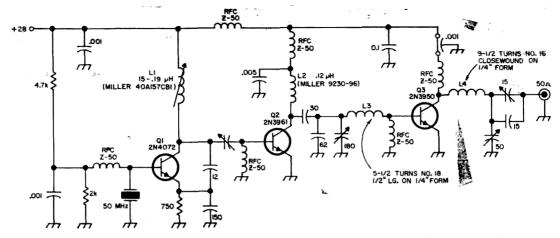


Fig. 55. This 6 meter transmitter provides up to 50 watts of power with very good efficiency and very low harmonics. The 2N3950 in the final provides a minimum power gain of 8 dB on six and is rated at 50 watts continuous service.

Six meter transmitter

The six meter transmitter of Fig. 55 will provide 50 watts of power into the antenna with very good efficiency and very low harmonics. The second harmonic is suppressed on the order of 28 dB while the third harmonic is more than 34 dB down. The efficiency of the final stage is 69% and the overall efficiency of the entire transmitter is 62%. The bulk of the total current drain of 2.9 A is required by the final amplifier -2.6 A. By choosing each of the circuit components very carefully, a transmitter evolved which uses only three transistors where several more stages are normally

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- 8 TURNS 88W 3003 (I6 TURNS PER INCH, 1/2" DIAM.)
 TAPPED AT 4 TURNS FROM COLD END.
 8 TURNS NO. 16, 5/16"2IAM, 1" LONG
 3 TURNS NO. 16 BIFLAR WOUND ON COLD END OF L2.
 2N384, SK3008, TIXM03
- L2

Fig. 56. This simple two meter transmitter may be used as a driver for a larger 144 MHz transmitter or a signal source for testing receivers, converters and antennas.

required. The mainstay of this transmitter however is the 2N3950 transistor in the power amplifier; this transistor can provide 50 watts of continuous power at 50 MHz with a minimum power gain of 8 dB.

Two meter driver

The simple two meter driver shown in Fig. 56 is just about the minimum that is suitable for driving a small 144 MHz transmitter. The first stage of this VHF driver consists of a crystal controlled oscillator operating at 48 MHz; the 48 MHz output from the oscillator is capacitively coupled to the 2N1141 tripler stage tuned to 144 MHz. The two meter output of this circuit is quite low, but sufficient to drive a small power amplifier to a quarter watt or so. This circuit may also be used as a two meter signal source, or as a source for a VHF SSB mixer.

Circuits for Test Equipment

Signal tracer

The signal tracer is a universally used unit of test equipment which may be used for troubleshooting and isolating defective stages in all types of electronic equipment. With a suitable rf probe it may be used to check the operation of rf and if amplifiers; with an audio pickup probe it may be used as a straight through audio ampli-

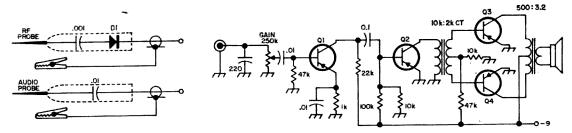


Fig. 57. This signal tracer provides more than adequate audio output with only 100-microvolts of modulated rf at the input. It may also be used for tracing audio circuits, but don't depend on its fidelity. All the transistors are germanium types such as the 2N404, 2N1450, 2N2953, SK3004, GE-2 or HEP-253; the diode in the probe is a IN34A or IN67A or similar.

fier to check microphones and preamps and to detect noise and hum in amplifiers.

The signal tracer shown in Fig. 57 uses a push pull output stage which produces more than adequate audio output to a miniature speaker with only 100 microvolts input. The output from the probe is applied directly to the 250 kilohm pot, which serves as a gain control and as a diode load when an rf probe is being used. The signal is coupled to the base of the first transistor, amplified, and fed to the driver stage and transformer coupled push pull output.

Only a very small amount of audio signal is necessary to operate the signal tracer as a straight through audio amplifier. However, don't use it to check fidelity because it is designed primarily for maximum sensitivity without regard to frequency response.

When using this signal tracer always start with the audio gain control turned all the way down because it is easy to overload the simple amplifier; the result is a highly distorted output signal. In some receivers the rf probe may load the mixer plate or if grid. If this happens, a tone modulated signal should be injected at the antenna terminals of the receiver to obtain a usable output from the signal tracer.

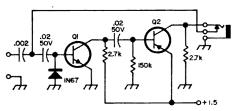
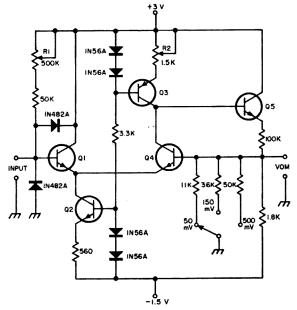


Fig. 58. This signal injector/tracer switches from the injection mode to a signal tracer by simply plugging in a pair of high impedance magnetic earphones. As a tracer is works from audio up to 432 MHz. Transistor Q1 is a 2N170, 2N388A, 2N1605, SK3011 or GE-7; Q2 is a 2N188A, 2N404, 2N2953, SK3004 or HEP-253.

Signal injector/tracer

The circuit illustrated in Fig. 58 functions as both a signal injector and signal tracer. Furthermore, no switching is required; it's all accomplished automatically when the headphones are plugged in for signal tracing. In the inject mode the circuit is a clamped multivibrator with extremely narrow pulses and high harmonic content. In fact, with this circuit, sufficient output is available for signal tracing from audio (750 Hz) to well above 40 MHz. This frequency range is more than adequate for most requirements.

The unit is switched to the signal tracer mode by simply plugging in a pair of high impedance magnetic headphones. In this mode



QI, Q2, Q4, Q5 - 2N13O4, 2N2924, 2N3393, SK3OII O3 - 2N4O4, SK3OO3, SK3OO4

Fig. 59. This VOM range extender increases the sensitivity of your volt-ohm-milliammeter to 50 millivolts full scale; full scale readings of 150 and 500 millivolts are also provided by the range switch.

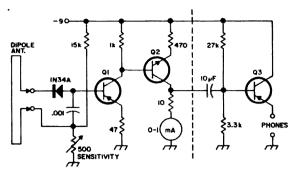


Fig. 60. This monitor/detector may be used for measuring field strength, monitoring modulation or finding hidden transmitters by simply attaching a resonant dipole antenna at the input. Q1 and Q3 are 2N408, 2N2953, SK3004, GE-2 or HEP-253; Q2 is a 2N170, 2N388A, 2N1605, SK3011 or GE-7.

it will detect and amplify signals from 20 Hz to above 432 MHz. Since this circuit only requires about 100 microamperes, no on-off switch is provided. This very small current drain insures that the life of the battery will be nearly that of its shelf life. By using miniature components and a little care in layout, it is possible to mount this complete injector/tracer in an old penlight case or metal cigar tube.

VOM range extender

Most volt-ohm-milliammeters are not too suitable for use with transistor circuits because their lowest voltage scales are either 1.5 or 3 volts full scale and they are not sensitive enough to accurately measure the base to emitter voltage of a transistor which may be 120 millivolts or so. The low voltage dc preamplifier shown in Fig. 59 is inexpensive, stable with temperature and supply voltage variations yet extends the range of any VOM so it can be used effectively in semiconductor circuit measurements.

In this circuit transistors Q1 and Q4 constitute an emitter coupled amplifier; Q5 is an emitter follower connected so the circuit's entire output voltage is fed back to Q4. Transistors Q2 and Q3 are constant current sources in the negative and positive lines respectively. These constant current sources reduce the sensitivity of the amplifier to voltage supply variations and result in substantially lower drift. To control the gain of the amplifier for different voltage ranges, a portion of the output voltage is fed back to the base of transistor Q4 through the voltage divider selected by the

range switch. With the values shown in the schematic, this circuit provides gains of 3, 10 and 30, which extend the 1.5 volt scale of the VOM to 500, 150 and 50 millivolts full scale.

There are two zero controls which must be adjusted when using this unit; first the 500 kilohm pot (R1) in the base bias lead to transistor Q1 is adjusted to zero the output with no input and the base isolated from ground. The 1.5k zero adjust pot (R2) is then adjusted for an output zero with the input leads shorted together.

Monitor/detector

The simple VHF monitor/detector illustrated in Fig. 60 may be used for measuring field strength, monitoring modulation or even in hidden transmitter hunts. The frequency of use may be simply changed by changing the length of the dipole antenna. In some cases where the rf field is strong enough, a simple vertical pickup antenna will be sufficient for signal monitoring purposes. Furthermore, the use of this monitor/detector is not limited to the VHF bands; the addition of an appropriate antenna will permit its use at any frequency up to about 500 MHz. For lower frequencies where the size of the dipole antenna would be impractical, a simple vertical pickup antenna and tuned resonant circuit may be substituted at the input.

1 kHz oscillator

The simple 1 kHz oscillator shown in Fig. 61 is very useful for many testing devices around the shop. This circuit is simply a Colpitts oscillator, but the circuit values and feedback have been chosen for maxi-

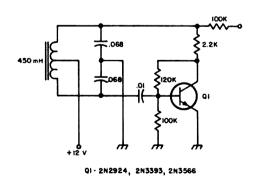
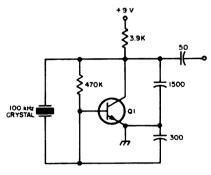


Fig. 61. Simple 1000 Hz oscillator is very useful for testing and measurement around the shack. The Colpitts circuit is used with component values chosen for maximum stability and good waveform.



Q1 - 2N7Q9, 2N2711, 2N2923, 2N3691

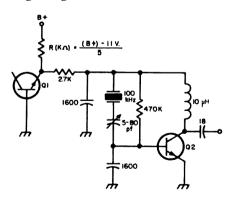
Fig. 62. The 100 kHz calibrator shown here is just about the simplest circuit that will provide usable results. For zeroing in with WWV a small padder capacitor may be added in series with the 100 kHz crystal.

mum stability along with good waveform. It may be used for testing speech and modulation equipment, or even as a driver for a code practice oscillator.

100 kHz crystal calibrators

The 100 kHz crystal oscillator illustrated in Fig. 62 is just about as simple as you can build and still get a usable output. This circuit will provide usable harmonics up to about 30 MHz but it has no provision for zeroing in with WWV. This feature may be added by simply placing a small variable padder capacitor in series with the 100 kHz crystal.

The calibrator circuit shown in Fig. 63 is only slightly more complicated than its counterpart in Fig. 62, but provides usable harmonics up to 150 MHz and has a built in voltage regulator. In this case the base



QI ANY NPN PLANAR SILICON TRANSISTOR Q2 2N2925, 2N3392, 2N3565, SE4002

Fig. 63. This 100 kHz crystal calibrator is only slightly more complicated than the one shown in Fig. 62, but has a built in voltage regulator (QI) and provides usable harmonics up to 150 MHz.

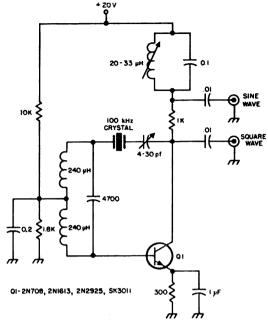


Fig. 64. This 100 kHz crystal calibrator uses a crystal in the parallel mode and provides either a sinusoidal or square wave output. The calibrator may be zeroed to WWV with the 4-30 pF trimmer.

to emitter junction of an NPN silicon planar transistor is connected as a zener diode. When connected in this manner, these transistors provide a regulated voltage of approximately 11 volts. The value of the series dropping resistor may be determined by using the formula shown in the schematic. The 5–80 pF capacitor is for zeroing in with WWV.

The 100 kHz crystal controlled oscillator shown in Fig. 64 uses a low cost silicon transistor, and provides both a square wave and sine wave output with excellent frequency stability. The oscillator circuit is basically the Hartley type with positive feedback from the collector to base through a phase reversal in the tapped tank circuit, consisting of two 240 µH chokes and a 4700 pF silver mica capacitor. The oscillator frequency is determined by the resonant frequency of the very high Q series LC network in the feedback loop. This network is made up of the 4-30 pF variable capacitor and quartz crystal which operates in the parallel mode. The variable capacitor provides a fine frequency adjustment control. Feedback is sufficiently large to assure normal circuit operation almost completely independent of transistor gain. The large amount of feedback drives the collector from cutoff to saturation, making a square

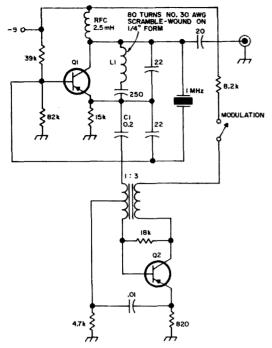


Fig. 65. This crystal controlled oscillator provides very distinctive markers up to 30 MHz. The modulation frequency is approximately 1000 Hz, but by changing the value of C1 it may be changed slightly. Q1 is a 2N384, 2N1742, 2N2362, 2N2084, TIM10, GE-9 or HEP-2; Q2 is a 2N2613, 2N2953, 2N1303, SK3004, GE-2 or HEP-254.

wave available at the output. A sine wave is developed across a tunable high Q tank and is also available at the output.

Modulated band edge marker

The crystal controlled calibration oscillator shown in Fig. 65 is especially useful for band edge marking and providing distinctive crystal controlled markers up to 30 MHz. To assist in identification of the marker, particularly at the higher frequencies where the harmonics are quite weak, the note may be modulated by simply turning on the audio oscillator. The modulation frequency of this unit is about 1000 Hz, but it may be changed slightly by changing the value of C1. If the oscillator fails to oscillate when power is applied, reverse the connections on one side of the transformer. At the lower frequencies the output of the calibrator may be coupled into the antenna circuit of the receiver by inductive coupling, but on 15 and 10 meters, a direct connection to the antenna terminals may be necessary to obtain sufficient output. Although this circuit is designed for a one MHz crystal, other crystal frequencies may be accommodated by changing the number of turns in LI.

The two meter band edge marker illustrated in Fig. 66 provides very strong harmonics of an 18 or 24 MHz crystal on 144 MHz; when a sensitive converter is used on 432, harmonics may also be heard on this band. This circuit will oscillate with crystals throughout the 18 to 24 MHz region, so it may be used as a marker at almost any VHF frequency. The use of a 20 MHz crystal for example would be very useful for marking the lower edge of the amateur 220 and 420 MHz bands. If a modulated marker is desired, the audio oscillator (Q2) of Fig. 65 may be coupled into the base of the oscillator through a 0.2 µF capacitor.

Sweep frequency generator

More and more hams are finding out that the sweep generator is one of the most useful test instruments to have around the shack. It may be used to align communications receivers, VHF converters, to plot response curves and to check bandwidth. The circuit illustrated in Fig. 67 is a very simple unit that may be used at any spot frequency between 100 kHz and 60 MHz. Although a three range bandswitch is shown in the drawing, it may be omitted if only one spot frequency is required (455 kHz for example).

The sweep generator shown here consists of a single unijunction transistor sawtooth generator which provides the sweeping signal for the oscilloscope and the fixed tuned rf oscillator. The output of the sawtooth generator is connected across a 56 pF varicap in the oscillator tank which varies the frequency of the oscillator in step with the scope trace. The sweeping frequency may

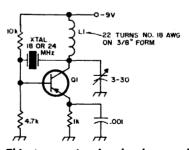


Fig. 66. This two meter band edge marker provides useful harmonics up to several hundred MHz with 18 or 24 MHz crystals. If modulation is desired, the audio oscillator from the circuit of Fig. 65 may be coupled into the base. Q1 is a 2N1745, 2N2362, or HEP-2.

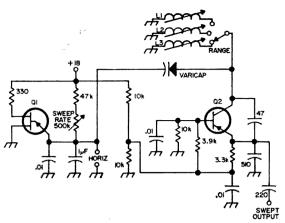


Fig. 67. A sweep frequency generator is a very handy gadget, but many times the commercial units are more complicated than the ham requires. This simple sweeper may be used at any spot frequency between 100 kHz and 60 MHz by simply using the coils listed in Table 2. By using a three position range switch, the three most popular frequencies may be used, such as 455 kHz, 1600 kHz and 10.7 MHz. QI is a 2N1671, 2N2160, 2N2646, 2N3480. or HEP-310; Q2 is a 2N741, 2N1747, 2N2188, GE-9 or HEP-2. The varicap is a 56 pF capacitance diode such as the 1N955 or TRW V56.

be varied between 5 and 30 sweeps per second with the 500k sweep rate control.

The center frequency of the swept output is determined by the coils that are connected across the range switch. A listing of coils for all frequencies from 65 kHz to 60 MHz is listed in Table 2. When using this generator, always use the slowest sweep speed that will provide a usable trace on your oscilloscope. The slower the sweep speed, the more accurate the reproduction of the response curve; if the generator is swept at too fast a rate, the resonant circuit being swept may ring and distort the curve.

Table	2
COIL	æ

Frequency	Miller No.
65 kHz —140 kHz	9007
95 kHz —190 kHz	9006
150 kHz —300 kHz	9005
190 kHz —550 kHz	9004
380 kHz —1000 kHz	9003
700 kHz — 1.8 MHz	9002
1.4 MHz— 3.7 MHz	9001
3.7 MHz— 4.7 MHz	4508
4.7 MHz— 5.9 MHz	4507
5.9 MHz— 7.5 MHz	4506
7.5 MHz— 10 MHz	4505
10 MHz— 14 MHz	4504
14 MHz— 18 MHz	4503
18 MHz— 23 MHz	4502
23 MHz— 29 MHz	4304
29 MHz— 36 MHz	4303
36 MHz— 45 MHz	4302
45 MHz— 60 MHz	4301

Sawtooth generator

Sawtooth generators are very useful in many measurements and their circuitry may be greatly simplified by the use of field effect transistors. When conventional junction transistors are used for this purpose, complex feedback networks and methods of compensation must be used to generate a linear voltage ramp. The output waveform of the sawtooth generator shown in Fig. 68 is linear within 2% and may be adjusted from 1 kHz to 3 kHz by the center frequency control. The thermistor R1 provides temperature stability and circuit loading is reduced by the use of a source follower at the output.

Square wave generator

The square waves available from most inexpensive signal generators deteriorate pretty badly at the higher frequencies. In

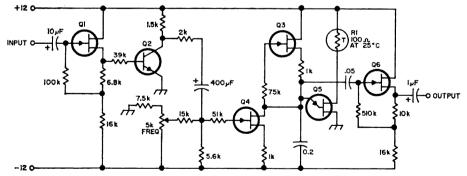


Fig. 68. This simple sawtooth generator is linear within 2% and may be adjusted from 1 kHz to 3 kHz with the center frequency control. Q1, Q3, Q4 and Q6 are FET's such as the 2N3819, 2N3820, TIS34, MPF105 or HEP 801; Q2 is a 2N388, 2N2926, 2N3391, SK3011 or HEP-54; Q5 is a 2N1671, 2N2160, 2N2646, 2N3480 or HEP-310.

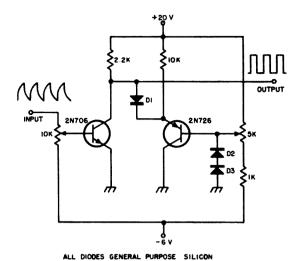


Fig. 69. The square wave output of many inexpensive signal generators deteriorates guite badly at high frequencies, but this circuit will square them off again. The diodes may be any inexpensive computer type such as the IN914.

addition, the output amplitude often varies with frequency. The addition of the simple circuit illustrated in Fig. 69 to the output of the signal generator will provide a good square wave output with an amplitude that does not vary with frequency.

In this circuit, Q1 is an inverter, while Q2 and the 5 kilohm amplitude control pot provide a variable clamp voltage for the output. In most cases, the necessary positive and negative voltages may be obtained from the signal generator's internal supply. The input potentiometer should be adjusted for best output waveform. Once this control is set, it will not change unless the signal generator varies significantly. Ideally, this control should be adjusted so that the input signal provides a voltage swing at the base of Q1 from +3 to -5 volts. The silicon diode D1 provides protection for the emitterbase junction of Q2. Diodes D2 and D3 prevent the clamp voltage from reverse biasing Q1.

Capacitance meter

The direct reading capacitance meter illustrated in Fig. 70 has four direct reading capacitance ranges from zero to 0.1 µF. Although electrolytic capacitors cannot be measured with this circuit, any type of nonelectrolytic capacitor may be checked. In fact, it works as well with variable capacitors as with fixed; the meter deflection will follow the capacitance change as it is tuned. The four direct reading ranges are 0-200 pF, 0-1000 pF, 0-0.01 µF and 0-0.1 μF. The lowest capacitance which may be accurately read is 4 pF, but 2 pF may be estimated quite easily.

In this circuit transistors Q1 and Q2 are connected in a conventional free running multivibrator. The output from the collector of Q2 is a constant amplitude square wave whose frequency is determined by the values of the resistors and capacitors connected across the base circuit of Q1 and Q2. The square wave output from the collector of Q2 is coupled through the unknown capacitor connected across the test terminals to the metering circuit consisting of the 1N34A diode, the potentiometers and the de microammeter. For any given square wave frequency, the deflection of the meter will be directly proportional to the capacitance across the test terminals. For example, if a precision 100 pF capacitor is connected across the test terminals and the calibration pot is set for full scale deflection, the

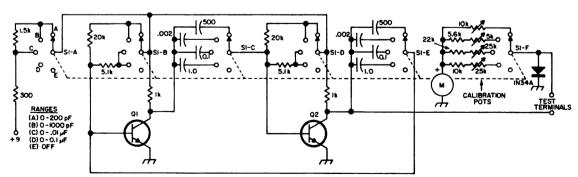


Fig. 70. Although this capacitance meter will not measure electrolytic capacitors, it will measure any other type from zero to 0.1 μF with reasonable accuracy. On the lower end 4 pF can be read accurately and 2 pF easily estimated. Transistors QI and Q2 are 2N168, 2N1605, 2N2926, SK3011 or HEP-54; the meter is a 0-50 microampere unit and the range switch a Centralab PA1021.

meter will have a range from zero to 100 pF. The response of this circuit is essentially linear, so 50 pF would provide half-scale deflection, ½0 scale deflection would indicate 10 pf, etcetera. To change the range, the frequency of the multivibrator is changed by choosing new values of resistance and capacitance in the base circuits of Q1 and Q2.

Calibration of the direct reading capacitance meter requires the use of four accurately known capacitors—0.1 μ F, 0.01 μ F, 1000 pF and 200 pF. These capacitors should be very carefully chosen because the accuracy of the completed meter depends on the tolerance of the calibration capacitors. In addition, it is essential that they are not leaky; if they are, the calibration will not be accurate. To calibrate the meter, set the range switch in the appropriate position, connect the respective calibrating capacitor across the test terminals, and adjust the calibrating potentiometer for full scale deflection of the meter.

Although electrolytic capacitors cannot be measured on this instrument, it will check all other types. If a capacitor is open, there will be no deflection on any range. If it is leaky or shorted, the meter will deflect below zero. It is imperative that leaky and shorted capacitors be immediately disconnected from the test terminals to prevent damage to the diode and microammeter.

High impedance scope probe

Most oscilloscope probes are unsuitable for use with high impedance circuits because they severely load them down. By using the high input impedance characteristics of the field effect transistor, an extremely high impedance probe may be produced. The circuit shown in Fig. 71 uses

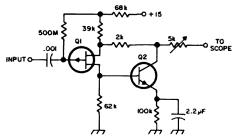


Fig. 71. This high impedance probe provides about 1200 megohms input impedance with unity gain. Upper frequency equalization is provided by the 5K pot. Q1 is a U112, 2N2607, 2N4360 or TIM12; Q2 is a 2N706, 2N708, 2N2926, 2N3394, or HEP-50.

the bootstrap action of the 500 megohm resistor to raise the input impedance of the circuit to 1200 megohms. The 2 kilohm feedback resistor from the collector of Q2 maintains unity gain while the 5k potentiometer provides circuit equalization. The rise time of this circuit is extremely fast, typically less than half a microsecond. In addition, it can handle up to two volt signals (peak to peak) without distortion.

Microammeter amplifier

The sensitive microammeter amplifier illustrated in Fig. 72 may be adjusted from approximately 2 μ A to 100 μ A full scale deflection each side of zero. The input impedance of this circuit is 60 kilohms at 2 μ A sensitivity and 2.5 kilohms at 100 μ A sensitivity; total battery drain is 1.5 mA.

In this circuit a differential amplifier with degenerative biasing and collector meter feed provide a satisfactory compromise between sensitivity and stability. The transistors used in this circuit should be chosen for high current gain throughout the emitter current range; in addition, they should exhibit very low leakage currents. The 50 ohm null potentiometer is used to compensate for any differences in the base-emitter voltage of the two transistors. The balance pot is used to compensate for dif-

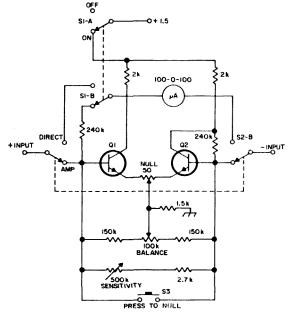


Fig. 72. This very sensitive microammeter amplifier may be adjusted from 2 μ A to 100 μ A each side of zero; the input impedance varies from 60K at 2 μ A to 2.5K at 100 μ A. Transistors Q1 and Q2 are 2N930, GE-10 or HEP-50.

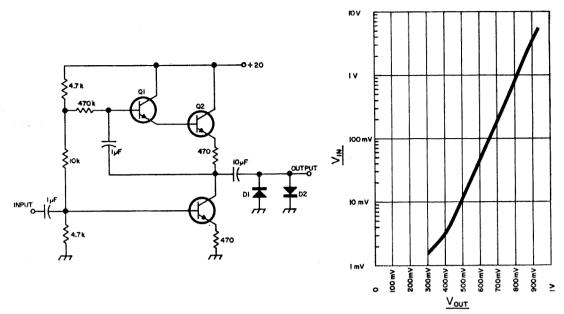


Fig. 73. This logarithmic amplifier makes use of the fact that when two back to back diodes are driven by a current generator, they exhibit a logarithmic output of the input signal. With the circuit constants shown, this amplifier follows a nearly perfect logarithmic curve over a 60 dB range; selected diodes will increase this to 80 dB. Q1, Q2 and Q3 are 2N2924, SK3019, GE-10 or HEP-54; D1 and D2 are 1N914.

ferences in components and transistor current gain.

The null adjustment is made with S3 depressed, S1 on and S2 on "amplifier." The balance is adjusted with S1 on and S2 on "direct." Although the null is completely independent of the balance adjustment, the balance must be changed each time the null is changed. For improved sensitivity a 50-0-50 μ A meter may be used instead of the 100 μ A movement, but at the cost of reduced stability.

Logarithmic amplifier

Logarithmic amplifiers are very useful for making measurements that require very large changes in input voltage or current. The 60 dB logarithmic amplifier shown in Fig. 73 makes use of the fact that when two diodes are driven by a current generator, they exhibit a logarithmic output of the input signal. Two 1N914 diodes were

chosen for this amplifier because they follow an almost perfect logarithmic curve over a 60 dB range; by selecting diodes, it is possible to obtain the same type of curve over an 80 dB spread.

To insure that load changes are not affected by Q1, its output impedance must be extremely high; to cover the 60 dB range for example, the impedance must exceed 100 kilohms. This is accomplished by the Darlington pair, Q1 and Q2 and the 470 ohm resistor in the emitter of Q2. If Q3 is maintained in its linear range, its ac collector current is completely independent of the collector load. Hence, it presents a very high output impedance to the diodes; greater than 100,000 ohms with almost any silicon planar transistor. The input impedance of this circuit is approximately 2000 ohms, so it may be driven from a variety of sources.

... W1DTY

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The Importance of Being Grounded

Ground paths and ground connections are important at all frequencies from dc on up. As the frequency increases, however, the ground path becomes trickier and harder to predict. When time is spent making any ground path neat, direct and predictable, a potentially serious source of trouble in the circuit is eliminated.

Have you ever had rf all over the shack or a power amplifier or if strip just not act right? The trouble could be lack of a secure, solid, short rf return path to the cathode or emitter of the stage. An example of the need for a good return path is probably a few feet away as you read this. Notice the cord to the lamp you are probably reading by. It contains two wires, one to supply current to the lamp, and the other to allow the current to return thru the transformer. Notice (or be informed!) that both wires are the same size, correctly inferring that both are of equal importance. Remove one of the wires and no light! So watch your grounds and regard them as equal in importance with the coils, capacitors and other components of your rf cir-

An unpredictable ground on a power amplifier can produce rf all over the shack. To see why, let's remind ourselves of a few things about radio frequency energy. rf current always takes the path of least resistance and inductance. If a less inductive route exists around a long path than thru a shorter path broken by a bolted joint or partition, then the current will go the long way. Partitions are harmful to the return path because when they are tight, rf curents cannot go around them, nor can they penetrate thru to the other side. A phenomenon called skin effect causes rf currents to run only along the surface of a conductor, penetrating less than 10 mils at even the lowest amateur frequency in aluminum, even less in copper.

Additional things to remember are that bolted joints are always lossier than a straight plate, and rf energy does not like to go around sharp corners or around edges of material to get where it's going.

The way some power amplifiers are built, it's a wonder that they are as stable or as interference free as they are. Imagine the rf return current from a high power amplifier having to sneak along the chassis, once it leaves the output connector, going under partitions and across bolted joints to get back to the PA cathode. More than a bare minimum of it is going to go around, travelling along the outer surface of the rig. When this happens, the chassis radiates and sometimes develops an appreciable difference of potential from surrounding and perhaps better grounded metallic objects. Presto—a rig that produces rf in the shack.

What does one do about all of this? Simply provide a neat, direct and predictable ground for the stage. A flat piece of copper or other conductor run directly from the output connector to the cathode is best, a heavy wire can be used to get by on.

If no reasonably thin copper strap is available a favorite (and enjoyable) stunt is to cut a beer can at the seam (must be emptied first) and scrape away the lining where it is desired to solder. The half quart size is (smack) best. Aluminum is less satisfactory to use as all connections are normally only bolted down and a connection to the tube base and the cathode pin directly from the nearest point of the strip is not easy to obtain.

The rf current will flow along one side of this strip as the edge tends to restrict current flow to the surface upon which it was launched. When tying components to the strip, use the same side for best results, particularly at the higher amateur frequencies.

To complete the job, tie all bypasses and tuning capacitors directly to the strip, or run a large lead directly to them. Don't depend on a shaft bushing to provide the return path for these critical rf components as this path may be longer than the one discussed earlier that went from the output connector to the cathode. Most components that are adjusted in operating the gear end up bolted thru the front panel and really deserve a much better return path to the cathode than they usually end up with.

As the frequency of operation increases, the effects discussed will become more pronounced. Currents will travel ever closer to the surface and direct ground paths will become more important. They are already important at even the lowest amateur frequency.

Let's review the important points now that the groundwork (!) has been laid:

- 1. Use a neat, direct, predictable ground plate from output or load back to the cathode.
 - 2. Avoid bolted joints in the return path.
 - 3. Avoid going under tight partitions.
- 4. Tie all bypasses and tuning capacitor frames back to the ground plate. Remember that:
- 1. rf currents do not penetrate very deep but flow along the surface of a conductor.
 - 2. rf currents will not go thru a plate.
- 3. rf curents tend to stay on the suface upon which they are launched.

rf power amplifiers are not the only things that require good ground returns. That has been the main topic here, but the ideas are 100% applicable when constructing stable drivers, oscillators, rf and *if* amplifiers, and even audio amplifiers. They all deserve the same treatment: a neat, direct and predictable cathode return path.

The essential thought here is that the builder of any piece of gear should sit down and trace out the ground return path

of every stage. Where a direct path from one cathode or emitter to the next is not obvious, continuous and relatively unimpeded—put it in yourself.

The results can be quite dramatic. A thousand watt class C amplifier that was recently designed and put into service here at WA6KLL was constructed using a 3" wide copper strip down the front panel and directly back to the cathodes of the two 813's. All bypasses from the tube socket were tied directly to this strip. The output connector and the tuning capacitors all mount thru the strip and the front panel and are strapped to the strip. The shielding to the compartment consists of aluminum screen with the frame secured by catches spaced at a quite wide 7 inch interval. There is no radiation of energy from the cabinet even with this minimal shielding. A portable TV ten feet away using an indoor antenna in our fringe area is unaffected when the transmitter is keyed, even on channel 2 (50 miles over hills). The ground return may not be the whole answer, but nobody's touching it!

The problem with specifying good return paths on circuits is that the schematic remains the same. If you are homebrewing from someone else's schematic, you had better know at least as much about the ground return problem as the designer or problems may occur. It is the rare construction article that delves far enough into fundamental" "well-known, concepts grounding. Usually the requirement for considering the returns is your responsibility as the builder. Failure to consider the ground path (since it is not particularly specified on most schematics) may be the cause of a perfect circuit that just doesn't work well for some reason.

If you ever have any doubt about the path return currents must take in any stage, provide one yourself that you can depend on. The results will often be well worth the trouble.

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Gus: Part 21

The trip to Mombasa was very enjoyable, plenty of good food and plenty of good rest. No/MM this time, the ship had a new wireless operator who knew nothing about ham radio, plus the fact he was new on the job and did not want to "take a chance", even tho I were willing and ready to get going from the ship. The rest did me plenty of good and I had time to get all my logs ready to be mailed to Ack upon my arrival in Mombasa. Good old Leny 5Z4GT and 5Z4AA met me at the docks when the ship arrived. 5Z4AA was way up in the Police Dept. and a nod from him to Customs did the trick. and in a few moments all my equipment was in Leny's car and away to my hotel we went. I spent only one or two days in Mombasa, did a little shopping down at the local market place—where all those carvings are-REMEMBER! I had nothing to trade them this time so I had to do it the hard way-by bargaining a few hours, even though I spent only about maybe \$10.00 I got a big armfull of some FB carvings. I had found out how to "bargain" with these people while "drinking their Cokes", and I still think they love it. A few even remembered me being there before-One referred to me as that big business man from America. They never say the U.S.A.-You know they call us Americans, this is true in every country I have ever visited. Not just Kenya. They were referring to my big business deal" that I had with them a few years previously when I traded all that "genuine

plastic" jewelry to them. THEY WANTED TO KNOW DID I BRING SOME MORE!!! They all thought I was a "Big Deal" fellow.

The evening's train was caught for Nairobi, you know it only makes that trip at night, I guess it's too hot to be made in the daytime, plus the fact at night they sell you a "sleeper coach ticket" and that puts a few more pounds in someone's pocket I suppose. Arriving back in Nairobi was sort of like coming back home, all the sights was familiar to me, even the taxi drivers with those LONG earlobes with the hole in them and the tall, Fez-sort-of-looking hats they wear. Good old George 5Z4AO met me at the train and away to his home we went, outside the city limits of Nairobi a few miles. Right besides hole Nr. 5 of a golf course which had that sign near hole Nr. 5, saying, "beware of the lions near hole 5". And don't think this sign is there just to be funny-there are LIONS around there, George said one night he saw five of them walking across his lawn. There are also hyenas there, George put a piece of meat on his front steps one night and about midnight there was that laughing hyena sound out on the FRONT PORCH, and there they were fighting over that chunk of meat. George at that time was working with Kenya Television near Nairobi and he had the usual "understudy" following him all over the place when he was on the job. His

MEAT AND POTATOES AND SOMETHING CALLED VALUE

I am always on the lookout for electronic components or assemblies which possess potential ham value. I have also been interested in any item which makes it possible for more hams to enjoy sideband. You can, therefore, understand how happy I was when on a recent western trip I found one lot of 225 watt core power transformers and in another area a batch of computer grade electrolytic condensers. Immediately, I felt that we could put out a darned good universal transceiver power supply and when I got back, the boys in the shop confirmed this.

I say universal because with two of these power transformers and two 500 mil chokes, 12 diodes, assorted resistors and other components, we were able to make up a supply which met the requirements of the latest Swan, Collins, Drake, Hallicrafters, Heath, and National transceivers. Talk about value! We can offer this complete assortment of parts including a 16 gauge steel chassis and bottom plate, a good PM speaker and mating plugs for your particular transceiver for just \$50. The transformers in this set weigh 17 lbs. and altogether the completed supply will weigh close to 40 lbs. This is what I call meat and potatoes. The filtering is excellent; the regulation is extremely good, and we have schematics and a printed story to be supplied with each kit, giving detailed infor-



mation as to how to make the connections for your rig. You will have to tell us what model vou own.

This is what the power supply will do: 800-1000 V at up to 400 mils on peak 285-320 V at up to 300 mils bias of up to 125V at 100 mils 12V DC at 1 ampere 12.6V AC at 6.5 amps Remember, this is an assembly of parts.

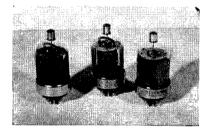
We do not furnish a drilled chassis; we do not furnish the hardware; we do not furnish the solder and the wire but literally everything else is supplied.

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understudy I think he said was "Kyuku," one of the natives of Kenya. George suddenly has left 5Z4 land you know for ZS6 land so I guess that 5Z4 fellow has stepped into his job. Boy I bet that Nairobi T.V. is not on the air 100% of the time. I guess being from ZS land (that's where George is from you know) is sort of tough on a fellow in 5Z4 land. Must be getting sort of tough all around now because Leny 5Z4GT, I understand will be leaving, I think next year for U.K. Sort of looks like all of them are leaving. Robbie is still there, had a QSO with Wayne Green W2NSD/1 from 5Z4ERR a few weeks ago. I wonder if he will be leaving one of these days? Maybe the day will come when 5Z4 will become a rare one? Maybe someone will have to go there to give the boys a new one some time. George told told me ALL ABOUT the situation when I were there, a very interesting story too. Time to depart for Ruanda and Burundi soon arrived and George took me down to catch the train. George's wife is incidently a good cook, fellows, hunt them up if you happen to get down to ZS6 land sometime. Tell em, "Gus sent me".

The trip to Lake Victoria was only a few hours, I saw the "Great Rift Valley" from the train. In fact the train goes thru the Rift Valley, a sunken portion of the country quite a number of miles across in this portion of Africa. I understand this Rift Valley extends from down near Northern Rhodesia all the way up thru Africa, across Asia Minor across Iran maybe even into Russia. Maybe part of it is in Eastern Turkey where they had the big earthquake a little while back. It could be seen very easily from the train. The land had sunken down some hundreds of feet I would estimate.

Arriving in Kismu on Lake Victoria the weather was extremely hot. Loading the Lake steamer took about four hours it seemed to me. The boat was full mostly of natives, some returning to their homes from working in Nairobi or maybe Nakuru or maybe even Mombasa. Quite a number of Europeans in their White suits also went on board. The steamer headed across the lake for Kampala, Ugunda. Taking about one half the day to get there. The ship was close to the land quite a while and many crocodiles were seen, even a few hippos and even some dozen or so wild water buffalosthats those "mean ones" that you don't monkey around with at all. Those are the ones you had better "kill" if you shoot at them or you are in for a lots of trouble. I was glad we were on a ship and they some distance away, even then they gave the boat a "mean look". The crocodiles just sank below the water and disappeared from sight. Upon landing in Kampala everyone went ashore and we were taken to a nearby water-front hotel and told to have a drink on the house, some of us wandered out and walked around town. I picked up a few carvings and some native-made items. The weather was too hot for me to walk all over so I headed back to the hotel/restaurant. Stayed there some three or four more hours until we were told to go back to the ship. The little whistle tooted a few times and we were away for the Sourthern part of Lake Victoria. The ship docked at Mwanza which is in Tanganyaki. This was where I was to meet 9U5JH from Ruanda. He was to arrive late that afternoon. I was met at the docks by a VQ3 fellow from either Kanama or Shinyanga where he was managing a diamond or gold mine. He was originally from ZS land so I am quite sure he is not in Tanganyake at this time. He drove me in his car all over the little town and we had a very fine meal at a local hotel-restaurant and chatted until late in the afternoon when John, 9U5JH arrived in his 1959 Chevrolet which he had driven all the way from Burunda. All three of us had a big "eye ball QSO" for an hour or two, the VQ3 chap departed for his home QTH, John gassed up filling a few five gallon cans full of gasoline for the trip back to Burunda across unchartered roads with no filling stations and no signs of civilization at all were seen by us as we drove to 9U5 land that night. All THREE SPARE tires was carefully checked, two spare cans of water was filled, a few extra quarts of oil were bought, and away for 9U5-Burunda we went. Now don't get the idea that there is an "interstate highway between these two places, don't get the idea that it's even a paved road, or you will be completely wrong. This auto trip was nearly what you might call a safari. We were packed for a safari I would say. We had everything a safari has except "guns". Later on I sure wish we had a gun or two with us. This was going to be another of those trips I was to remember all my days. Dirt roads all the way, not one single road sign and many many roads turning off to the right and left. All of them

102 73 MAGAZINE

looking right to me. A few times we chose the road by refering to our compass. OH YES we took quite a few wrong roads. John could speak Swahili so we had no trouble getting back on the right road, but if you don't speak Swahili-Brother don't vou dare make this trip or you will end up staying there all the rest of your life. No one we met all the way spoke ONE WORD OF ENGLISH, and Brother this can get rough. Most of the natives were more or less friendly, but a number of them looked downright "mean" to me, not a sign of a smile could be seen on their faces. When you leave the town limits of Mwanza and are out on that road a few hours, you know you are in "deep Africa", you smell it, you see it, you hear it, you hear in the distance the beating drums (this trip was an all night affair you know), even the stars sort of have that African look, the trees are a dead give away. You remember seeing those "flat top" trees in African movies? Well they are here, and I mean all over the place. Those darn beating drums are what got to me more than anything else, some sounded like they were saying bong, bong, bong diddy bong, others sounded like bang, bang space bang bang bang, All had a different sound and were beat in a different sounding way. I was thinking to myself something like this-"I wonder what those things are saying to each other". Because some of them were most certainly answering the other drummer's CQ. I wonder when they sign off do they have a certain thing that says 73? Those jungle sounds were sometimes frightening, at times smooth, and sort of soothing. I had been in the African jungle before a number of times between Mombasa and Nairobi, Kenva and twice between Nairobi and Dar es Salaam, Tanganyaki, but I was in a bus along with about 25 or so people all the time and on at least a 'marked road". You might say the other roads were roads that were traveled on by a good number of cars every day. But this was now a real "back country" road and lead us straight in the middle of real wild country-a part incidently where Dr. Livingston went for supplies to Dar es Salaam and very definitely a portion was used by Stanley when he was hunting Dr. Livingston. This was an all night trip and half of the next day. You know wild animals are daytime sleepers and roam around at night. So doggoned many different kinds of ani-

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- Advanced circuitry utilizing 35 semi-conductors most of which are silicon.
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mals was seen it's hard to remember them all. John (9U5JH) had along in his car a head light sealed beam light mounted on the end of a short handle with the end of its cord a plug that we plugged into the cigarette lighter on the dasboard of his car. When we saw a pair of eyes in the distance I would snap on the light and zero in on them and keep the light in their eyes until they disappeared into the jungle. Most of them did not try to evade staying in the light. Many many lions, big baboons, antelopes, zebras, rhinos, elephants and best of all quite a few big beautiful leopards setting up on rocks beside the road ready to pounce on anything that happened to pass their way. When we passed them you can bet the windows were rolled up. We did not want a leopard jumping in our car. These rascals usually would just set there watching the car as it passed. A few times we pulled up and stopped parallel to them and I kept the light in their eyes and had a good chance to look them all over. Boy, if we only had a gun along with us, Peggy would have had a few leopards skins towards a leapord skin coat. It would have been so easy to shoot them smack between the eyes and not even leave a bullet hole in their skin. But all we could do was just "look" at them from the safety of our car.

Lions: this was their hunting grounds, they were to be seen at least every half hour. We would see from one to three or four, I mean right beside the road. They were like the leopards-not afraid of anything. The most numerous of all animals was those hyenas. Many other animals were seen. Many of them, not even John knew their name, some looked sort of like our American racoons and opossoms. My flash no pictures was taken I am sorry to say. Even a few very large snakes crawled across the road, probably pythons. This was the real African jungle and I was a little bit on the edge everytime we stopped the car, wondering if it would start again O.K. My only regret was that it was a fast trip without many stops along the way. After the all-night trip from Mwanza and driving all the next morning we arrived at Kitega, Burundi and drove a few miles from town to the home QTH of 9U5IH which was at a missionary settlement on top of one of those hundreds of little hills that you see in Burundi. As a rule the Eruopeans build their homes on top of these hills and the natives build theirs down in the valleys between the hills. The natives lived in typical thatched huts with many many banana trees all around their settlements. I asked John why all the banana trees, thinking they exported bananas, and he said they made banana wine from the fruit. He said this banana wine was very powerful stuff and that great quantities of it was consumed by the natives. We also saw quite a few tea plantations here and there usually on the side of the hills. The temperature was not too bad on top of those little hills. Usually a slow breeze blew during the daytime and at night it was very pleasant, late at night getting a little chilly. John had up a real nice 20-meter quad, maybe it was also 10 and 15 because it was of the center spider construction. His equipment was cleared from the operating table and mine was placed there and tuned up. I was on the air as 9U5JH, the band stayed open until about 3 AM and was open to everybody all at the same time. All my "Gus watchers" were in the pile-up and I had a ball with FB signal reports from everywhere. Nearly everyone saying I was a new country for them, which I doubt since John had always been quite active and many other 9U5's from Burundi had been on for many years. I am a firm believer that, "if you are the rarest thing on the air, you automatically become DX to everyone everywhere, and they will join in the pack just to be working DX. Of course this suited me FB because the bigger the pile the better I like it. A DXpedition wants big business, that's the reason there are DXpeditions you know. John filled up the coffee pot and told me how to heat up the coffee. Milk and sugar was on hand and everytime I got a little sleepy, to the coffee pot I went. John had a nice wife and she was a good cook so there was always plenty of good food there. My stay with John was one of those good ones. The kind you are always looking for when you get away from home. John told me many stories about what has happened there since he had arrived, lots of good ones about lions getting into native huts, gobbling up a few of them, then their lion hunt to get the "man eater". You can be sure these things do happen in deep Africa, they right now have lion trouble in some of the out laying places I am sure. That's it for now fellows, MORE NEXT MONTH.

. . . W4BPD

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Waters' Dummy Load and Wattmeter

The new dummy loads from Waters Manufacturing down in Wayland, Massachusetts, nicely fill the amateur need for a dummy load and/or wattmeter that he can depend upon. The two models are basically the same load, but the Model 374 has a built in wattmeter while the Model 384 does not. These loads consists of a structured monolithic 52 ohm non-inductive resistance unit designed to present a constant impedance of 52 ohms over the frequency range from dc to 230 MHz. To provide adequate cooling when large amounts of power are dissipated by the resistor, it is sealed into a steel container filled with oil; a thermostat is also sealed into the container as an indicator of maximum safe operating temperature.

Since the impedance of a load of this type is dictated solely by the physical geometry of the load resistor, once it is sealed into the can, it cannot be adjusted. However, the manufacturer states that the maximum SWR is less than 1.3:1 from dc to 230 MHz,

and tests with a commercial SWR bridge bear this out. The load is somewhat flatter (closer to 52 ohms resistive) on the high frequency bands up to 30 MHz than on the VHF bands, but even at 230 MHz the measured SWR was less than 1.3:1.

The two loads appear to be identical except that the 374 Dummy Load-Wattmeter has a built in rf wattmeter. This wattmeter consists of a semiconductor rectifier and filter network which furnishes a dc voltage to the meter movement from the rf voltage across the load. The dc voltage is connected to the meter through four resistive attenuators to provide full scale readings of 15, 50, 300 and 1500 watts. This instrument is calibrated at the factory with a precision low frequency wattmeter and the guaranteed accuracy from 2 to 30 MHz is \pm 5% of the full scale reading on each range. This means that on the 1500 watt range the reading is \pm 5% of 1500 or \pm 75 watts. The accuracy from 30 MHz to 230





MHz is not stated by the manufacturer because the power readings above 30 MHz will be somewhat higher than predicted. However, the 374 may be used as a relative power indicator up to 450 MHz; above 230 MHz the power input should not exceed 250 watts.

One very nice feature of the wattmeter is that it is possible to run a quick check on the calibration with normal 120 Vac, 60 Hz, line voltage. Immediately after calibration, the technicians down at Waters make a note of the reading obtained on the 50 watt scale when 120 Vac is applied to the input terminals of the model 374 and record it on the rear panel of the instrument. No attempt should be made to correlate actual power levels at 60 Hz with the wattmeter readings. because the circuit is not compensated for this frequency, but it does give the ham out in the field an opportunity to check the cali-

These loads are very useful for loading your transmitter without radiating a signal and for measuring the power output of your transmitter. The Model 384 does not have a built in wattmeter, but it may be used with the Waters 369 Reflectometer to provide accurate, direct measurements of rf power. If your antenna is very closely matched to 52 ohms, your transmitter may be loaded into the dummy load and then switched to the antenna with no changes in final amplifier tuning. If a coaxial switch is used to switch the transmission line from load to antenna, make sure you turn off the transmitter when switching.

The wattmeter is also useful to checking the loss of coaxial transmission lines and

Waters' Model 384 Dummy Load Specifications

Frequency range: Load impedance: Power rating:

DC to 230 MHz. 52 ohms nominal. 1500 watts (intermittent). (Maximum inner case temperature of 220° reached in 4 to 6 minutes at 1500 watts input).

Input connector:

Size:

Price:

Power Requirements:

Hermetically sealed SO-239 UHF mates with standard UHF PL-259 plug.

Weight:

120 Vac, 60 Hz (for over temperature warning light). 434"x9"x1014' 12 pounds. \$65.00

Model 374 Dummy Load - Wattmeter **Specifications**

Same as for the Model 384 above except as follows:

Wattmeter ranges: 0-15, 0-50, 0-300, 0-1500

watts. Accuracy:

 \pm 5% of full scale from 2 to 30 value MHz. May be used as a power indicator from 30 MHz to 230 MHz without statement of accuracy.

Price: \$135.00

for checking and adjusting SWR bridges. If you suspect that old World War II coax you're using is lossy, a quick check on the Waters 374 will confirm (or deny) it.

Once you have one of these units in your shack, whether it's the 374 Dummy Load-Wattmeter or the 384 Dummy Load, you'll wonder what you did before you got it. Besides, all your ham buddies in town will be . . . W1DTY over to borrow it!

WTW News

We've printed up a small WTW countries list which you can use to check off each WTW country as you work it. It has a place for the date of each QSO and a place to check when you receive the QSL. Please send a self-addressed business envelope for your copy.

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- 10. George Banta K1SHN
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Questionnaire

What with new breakthroughs in semiconductors, two meter moonbounce, Don Miller, lasers and incentive licensings, we want to know your interests. Please clip, tear, rend, or in some way remove this questionnaire (or even just copy it) and let us know post haste your interests.

ailū	iei us know posi nasie your mieresis.
	Are you licensed? yes no
2.	Do you work in electronics? yes no
3.	How long have you been licensed? 0-1 year: 1-5; 5-up
4.	Class license? Nov; Tech; Gen; Cond; Adv; Extra
5.	Do you own an SSB transceiver- yes
6.	About how many hours a week do you devote to amateur radio? Please indicate the approximate percentage of your time you spend on the following:
7.	Bands used: 160M 80M 40M 20M 15M 10M 6M 2M 220MHz 432MHz other
8.	Modes used: SSB
9.	Ham activity: Rag chewing; DX; Traffic; Construction; Contests; other
10.	Do you belong to an amateur radio club- yes no
11.	How much do you expect to spend on amateur radio in the next year?
12.	What major items are you considering purchasing?
13.	You like to build, you say? What construc- tion articles would you particularly like to

A Hint for the TR-4

Occasionally a TR-4 transceiver owner lives near a high power broadcast station that concentrates an antenna pattern in his direction. The result maybe an annoying signal appearing on one of the ham bands.

To eliminate the trouble it must be determined if the interfering signal is the fundamental or a harmonic of the station. Generally this is very easy to do. If the signal comes in loud and clear with no distortion it can possibly be the fundamental. If there is distortion or garble the signal is a harmonic because every time the frequency doubles, the audio signal components double and the station sounds distroted. The frequency of the incoming signal has to be determined so that a trap can be installed in the transceiver.

In my particular case I was troubled by XERB at 1090 kHz coming in on the twenty-meter ham band. It was found that this signal could be almost eliminated by using a series tuned trap across the neutralizing capacitor in the driver grid circuit to trap out the interfering signal.

For this particular station the fundamental was the culprit and a trap was made by from a 37-250 pF trimmer capacitor and 0.1 mH rf choke in series across a 865 pF capacitor (C-43) located in the grid circuit of the driver.

After the trap is installed, listen to the station and tune the trimmer for a minimum signal. If the trimmer closes without tuning through a minimum connect a 100 pF capacitor across the trimmer. The choke in series with the trimmer resonants at 1090 kHz which does the trick. Frequencies not in the broadcast band will take different values which would have to be calculated for the interfering frequency.

Essentially what we have done is to trap out the interfering signal at the grid of the 6EA8 mixer tube. There is no reason why other transceivers using the final amplifier grid coil as the antenna coil coupled to the mixer, and having similar interference problems, could not be fixed by the same method.

. . . Ed Marriner W6BLZ

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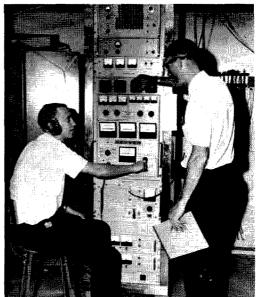
Dear Paul:

In your recent editorial you mentioned trying to create more interest in the 2.4 GHz band. You may be interested in the enclosed photographs showing an amateeur tracking experiment organized at Interstate Electronics by Jim Counter (K6AIP). This group successfully locked on and tracked the Surveyor moon probe. The antenna was a surplus 8 foot dish with a home brew feed mounted on a home made tracking mount. The preamp was borrowed from Mel Labs. The receiver is one which the group in the photograph designed and built for NASA. It is called the "General Concept Receiver" and is extremely flexible. It covers 70 MHz to 10 GHz and is triple conversion. Its main application is for reception of narrow band telemetry and doppler from space craft. Tuning is done by a "push button' frequency synthesizer.

The success of the first experiment has resulted in an organized effort to improve the antenna and mount for further amateur tracking experiments.

As you can see the people at Goldstone were quite surprised at the results of this effort.

Sam Kelly W6JTT Garden Grove, California



Kc. or kHz.?

Caen Van Necklaan 227, Rijswijk, Z. H.

Editor, QST:

Unnecessary to say, I'm as full of admiration for your fine paper as everybody else, but just this fact urges me the stronger to protest against one inaccurary. Some time ago you pointed out to all hams that it is much better to speak about frequencies than wavelengths, and the whole world has followed your example. But when speaking about frequencies, we mean the number of cycles per second, in any case the number of cycles in a certain time, and therefore it is wrong to speak about frequency of, for instance, 14,300 kilocycles; one should speak about kilocycles per second, abbreviated kc/s. Nobody would speak about coulombs instead of amperes, but neither should we speak of kilocycles when we mean kilocycles per second.

Now we have a new name for this unit, the Hertz, abbreviated Hz, which was internationally adopted by some congress. As Heinrich Hertz was without doubt an eminent and leading figure in physics, and as it is easier to type and print kHz than kc/s, I think you had better adopt it, too, before you lead all hams in the world astray by the wrong unit, the kilocycle, which you are using to-day.

-W. Keeman, PAOZK.

While agreeing with the author of this letter on the merits of the term "kiloHertz" as a unit of frequency, QST is inclined in this respect to follow the recommendations of the Committee on Standardization of the Institute of Radio Engineers, which is still at work in collaboration with other agencies in the standardization of radio definitions, nomenclature, measuring practice, etc. The current recommendations of that committee gives the meaning "kilocycles per second" to the abbreviation "kc.", exactly as attaches to the abbreviation "kHz." The "kiloHertz" is not yet a recognized unit of frequency either in this country or in the international literature, and for that reason QST does not use it.—Editor.

From QST, page 58, September, 1930.

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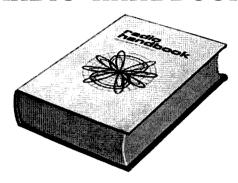
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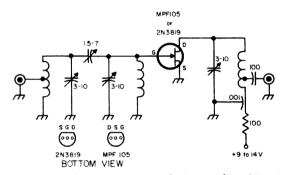
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What's New for You?

OOP Transistor Notes

\$1FET's I tried the inexpensive Motorola FET's in a number of circuits and found them quite satisfactory. I would use them without hesitation in the second stage and mixer of the 2 meter converter described by K6HMO in the October issue, and would use them for all stages on six or below. They are about a decibel noisier at 220 MHz than the TI plastic-cased units (2N3819), but nevertheless quiter than a 417A at that frequency, which is pretty good for a buck. The numbers are MPF103, MPF104 and MPF105. These are N-channel symmetrical FET's similar to the 2N3819, but with a



220 or 144 MHz preamp using \$1 Motorola MPF105's or \$4 Texas Instruments 2N3819. The \$4 one is about a dB better. Dip the coils to frequency. The input tap is about 50% up, output is 20%. Adjust everything for best NF. W100P got 1.8 dB.

different base. The MPF105 has the highest transconductance and the lowest noise figure. Its best NF is at zero bias, also like the 2N3819. MPF is about a buck; the 3819 is about four. The MPF105 is equal in noise figure to a 6CW4. I got 4.1-db NF at 220 MHz with the best of the Motorola units and 2.5 dB for the best 2N3819.

Fairchild 2N4122: I am really impressed by the Fairchild 2N4122. It isn't more anything than anything, but it is silicon, and it is a good replacement for PADT and such germanium transistors where heat turns out a problem. (Note that silicons may not be very good below zero degrees F, though the germanium transistors get better down as low as you are likely to get.) The 220-MHz NF of 4-5 dB of those I measured beats the Philco T2028 and is about even with the 2N2398 and 2N2494-5, considered very good three years ago. Price under a buck. Also good for audio.

GE16K2: GE's 16K2 is a good NPN silicon, cheap, for local oscillator chains and such. NF is 3.5 to 4.8 dB at 220 MHz for 20 units. It's similar to the Fairchild 2N3563.

TI XM101 vs TI XM10: We've run some interesting comparisons of the TI XM101 (about \$20) and the TI XM10 (about 94c). 220-MHz NF of the 101's was 1.9 dB. One lot of XM10's ran 2.0 to 2.5 dB. The late, lamented, XM05-6's ran about 30% under 2 dB, with 1.5 and 1.75 measured.

The performance "

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150 MHz converter: Last week I made a 150 MHz converter for lab use. With four under \$1 types, 1 had a 3-dB NF. For anything better, another rf amplifier would be needed.

Fairchild 2N4342: I tried out the Fairchild P-channel 2N4342 FET. NF 6 to 7 dB at 220 MHz, which, with a 5 dB second stage, is about even with a short. Don't know if it had any gain or not. I had five, tried only three.

The above notes are all from Hank Cross W100P, who is generally accepted as knowing what he's talking about. The information on prices is approximate and subject to change or error. Get the specifics from your distributor.

Kindly Keyer

Dear Paul.

I have had considerable correspondence considering "The Kindly Keyer" in the July 73". It appears that there were a couple of minor problems in the article as it appeared, which we failed to catch.

First, there are a few discrepancies between the schematic and the p.c. board layout:

Corrections to p.c. layout, page 49

- 1. Q₅ and Q₆ (labels on same) should be interchanged.
- 2. A 33K resistor should be shown between base of Q_5 and emitter of Q_6 .

These are the only real errors which should be straightened out. However, in the case of Q_1 :

- 3. The 100 k could be changed to a 220 k.
- 4. The $.1\mu$ F capacitor could be a .22 F.
- 4. The .1 F capacitor could be a $.22\mu$ F. (These only affect the time constant of the blocking oscillator, and any combination would work, with a different setting of the speed pot.).
- 5. The 82Ω resistor could be attached to +4.5V. (This makes the side tone louder.)

Notice that the order of components in the base of Q_1 is different, but since they are in series, there is no electrical difference. Even a novice should know this, but it seems to bother some!

6. Labels could be affixed to three terminals in Q_1 - Q_2 block as shown.

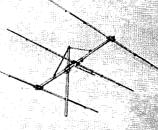
These changes would result in perfect agreement of p.c. board and schematic, but only 1 and 2 seem worthy of mention.

George Daughters WB6AIG



10 - 15 - 20 METER MONOBEAMS

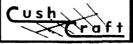
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stitute had plenty to do on its hands just filling in those areas where the League should have been active, but wasn't. Possibly this was a mistake. I suspect now that many more amateurs might have joined the Institute if it had been formed as a direct opponent of the ARRL, complete with hundreds of appointed officials all over the country to spread the gospel from head-quarters to the grass roots members, hoked-up elections of cardboard directors with no real say or even awareness of the real forces running things, official bulletins, inconsequential "services" and the whole ball of wax.

No, I goofed it. We set up with minimum of overhead, sent inexpensive letters to Congress, and ran the Institute without all the hoopla and big salaries. We also ran it without very many members for I found, to my intense disappointment, that without the Big Show there were very few dollars . . . or members to speak of. I tried telling the straight facts in my editorials, but found myself being called interesting names for trying to ruin the ARRL. Oh, I've centainly been critical of a couple of the top men running the League, no question of it. Few people have noted that none of these gentlemen will face me in public and answer my criticisms. But I've intentionally kept the Institute completely out of any hassel with the League and kept it on its published aim of speaking up for amateur radio in Washington.

All current members will receive a long and detailed account of the history and philosophy of the Institute, as well as a complete and detailed account of the income and expenses. And there'll be none of this vague coverup you find in the ARRL annual report.

How great is the disaster? In August 1966 there were six new members . . . September five . . . etc. There is no question at all that very few amateurs believe that there is any importance in th goals of the Institute. I suspect that the best plan is to not make any further effort to promote membership. I'll do what I can at my own expense to send information about amateur radio to Congress. Barry Goldwater has made some excellent suggestions for getting the most out of the least effort along this line. I'm going to keep pitching . . . sorry I failed to interest very many of you in the idea.

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		u		
D. C.	50Piv	100Plv	200Piv	300Piv
Amps	35Rms	70Rms	140 Rms	210Rms
3	.10	.15	.22	.33
12	.25	.50	.75	.90
18	.20	.30	.75	1.00
45	.80	1.20	1.40	1.90
160	1.60	2.90	3.50	4.60
240	3.75	4.75	7.75	10.45
D. C.	400Piv	600 Piv	700Piv	500Piv
Amps	280Rms	420 R ms	490 Rms	630Rms
3	.40	.50	.60	-85
12	1.20	1.50	1.75	2.50
18	1.50	Query	Query	Query
45	2.25	2.70	3.15	4.00
160	5.75	5.75	Query	Query
240	14.40	19.80	23.40	Query
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DX Flash

The DXers may be interested to know that as far as WTW credits for countries are concerned that not only do we accept anything as a country that is accepted by any national amateur radio society, but we feel that if a fellow operates from a country then contacts with him should count for that country. We do not feel that we should try to set ourselves up as official arbiters on exactly how legitimate a license is for any

In the U.S. there is little question about licenses. Either you have one or you don't. But once you get off the beaten path it is difficult to set up firm rules. In Nepal there is, the last I heard, one and one only legitimate licensed amateur and that is Father Moran 9N1MM. But other amateurs can and do operate with the knowledge and unofficial consent of the government. This same situation is true in several other countries I have visited . . . and things are even looser elsewhere. It becomes almost capricious to try to set oneself up as the "official" decider as to what is or is not licensed. Hence our decision that if he is there it counts.

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73 Magazine **CUMULATIVE INDEX**

October 1960-December 1966 Now available for 25¢ 73 Magazine

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Technical Aid Group

The first members of 73's Technical Aid Group are listed below. They are willing to help other hams with their technical problems. If you have a concise question that you think can be answered through the mail, why not write to one of the hams on the list? Please type or write legibly, and include a self-addressed stamped envelope. One question to a letter, please.

If you'd like to join the Technical Aid Group and you feel that you are qualified to help other hams, please write us and we'll furnish complete information. It's obvious that we need many helpers in all parts of the country and in all specialties to do the most good. While 73 will try to help with publicity and in other ways, we want the TAG to be a ham-to-ham group helping anyone who needs help, whether they be 73 readers or not.

Don Nelson WB2EGZ, EE, 9 Greenridge Road, Ashland, N.J. 08034. VHF antennas and converters, semiconductors, selection and application of tubes.

Tom O'Hara W6ORG, 10253 East Nadine, Temple City, Cal. 91780. ATV, VHF converters, semiconductors, general questions.

Stix Borok WB2PFY, high school stu-

dent, 209-25 18 Ave., Baysida, N.Y. 11360. Novice help.

George Daughters WB6AIG, BS and MS, 1613 Notre Dame Drive, Mountain View, Calif. Semiconductors, VHF converters, test equipment, general.

Roger Taylor K9ALD, BSEE 2811 W. William, Champaign, 1ll. 61820. Antennas, semiconductors, general.

Jim Ashe W2DXH, R.D. 1, Freeville, N.Y. Test equipment, general.

J. Bradley K6HPR/4, BSEE, 3011 Fairmont St., Falls Church, Va. 22042. General.

Howard Krawetz WA6WUI, BS, 654 Barnsley Way, Sunnyvale, Cal. 94087. HF antennas, AM, general.

Robert Scott, 3147 E. Road, Grand Jet., Colorado 81501. Basic electronics, measurements.

J. J. Marold WB2TZK, OI Div USS Mansfield DD728, FPO San Francisco, Calif. 96601. General.

Hugh Wells W6WTU, BA, 1411 18th St., Manhattan Beach, Calif. 90266. AM, receivers, mobile, test equipment, surplus, repeaters.

Richard Tashner, WB2TCC, 163-34 21 Road, Whitestone, N. Y. 11357. High school student, general.

Wayne Malone W8JRC/4, BSEE, 3120 Alice St., West Melbourne, Fla. 32901. General.

(Continued from page 4)

to pay for equipment to the movement to form an effective Canadian amateur organization instead of expecting Canadians hams to be a small division of the US ARRL. Incidentally, it sounds like this is an excellent year to visit Canada. From all indications, Expo 67 will be a far more satisfactory world's fair than the one in New York. Maybe we'll see you there.

So there are the special issues of 73 coming up in the next few months. Each issue will also feature the usual selection of what we hope will be interesting, informative and entertaining articles. Be sure to be with us.

Writing for 73

So many people have sent for copies of our booklet, "Writing for 73," that we've had to reprint it. If you've thought at all about writing for publication, why not send us a self-addressed business envelope and we'll mail one out immediately. I have also compiled a list of articles I'd like to have for 73. Please mention if you'd like the list.

TAG

The Technical Aid Group (TAG) is starting to help hams with their technical problems. However, we need many mere helpers to be able to work effectively. If you feel that you're competent to help, and have a few extra hours to devote to helping other hams, we'd like to hear from you. Your main reward from this work will be a sense of satisfaction and a little publicity, though there are a few other benefits. Please write for details.

. . . Paul

Propagation Chart

MARCH 1967

J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	96	08	10	12	14	16	16	20	22
ALASKA	14	14	7.	î	7	7	7	7*	14	14	21	21
ARGENTINA	21	14	14	14	:	7	14	21	21	21	28	21
AUSTRALIA	21	14	14	7.	7.	7*	7*	14	. 14	14	21	21.
CANAL ZONE	14	14	14	14	7	7	14	21	28	28	28	21
ENGLAND	7	7	7	7	7	14	21	21	21.	21.	21	14
HAWAII	21	14	14	7	7	7	7	7.	14	21	21	21.
INDIA	7.	7.	7*	7.0	7*	7*	14	21	14	14	14	14
JAPAN	14	14	7*	7*	7*	7	7	7	7*	7*	14	21
MEXICO	14	14	14	7	7	7	7	14	21	21	21	21
PHILIPPINES	14	14	14	7*	7*	7*	7*	14	14	14	14*	14
PUERTO RICO	14	1-6	7	7	7	7	14	21	21	21	21	21
SOUTH AFRICA	14	14	7	7	7*	14	21	38	28	28	21	21
U. S. S. R.	7	7	7	7	7	7	14	21	21	14	14	14
WEST COAST	21	14	14	7.	7.	7	7	14	21	21	21.	21.

CENTRAL UNITED STATES TO:

ALASKA	21	14	14	7	1	7	7	7	14	14	21	21
ARGENTINA	21	14	14	14	7	7	14	21	21	21	21.	21.
AUSTRALIA	28	21	14	7.	7•	7*	7*	14	14	14	21	28
CANAL ZONE	21	14	14	14	7	7	14	21	28	28	28	28
ENGLAND	7	7	7	7	7	7	14	21	21.	21.	14	14
HAWAII	28	21	14	7	7	7	7	7	14	21	21	21
INDIA	14	14	14	7*	7*	7*	7.	14	140	14	14	14
JAPAN	21	14	14	7*	7*	7	7	7	7	7*	14	21
MEXICO	14	14	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	14	14	7*	7*	7*	7*	14	14	14	14*	14-
PUERTO RICO	21	14	14	14	7	7	14	21	21	21	21	21
SOUTH APRICA	14	14	Т	7*	7*	7*	14	21	28	21.	ž1.	21
U. S. S. R.	7	7	7	7	7	7	14	14	21	14	14	70

WESTERN UNITED STATES TO:

_												
ALASKA	21	21	31	14	7	7	7	7	14	14	21	21
ARGENTINA	21	21	14	14	14	14	7	14	21	21	21.	21.
AUSTRALIA	28	28	21	21	14	14	7	7	14	14	21	28
CANAL ZONE	21	21	14	14	14	7	7	14.	21.	28	28	28
ENGLAND	7*	7.	Ą	7	7	7	7*	14	14	21	14	14
HAWAII	28	28	21	14	14	14	7	7.	14	21.	28	2.8
INDIA	14	31	14	14	7*	7*	7*	7*	14	14	14	14
JAPAN	21	21	21	14	7*	7	7	7	7*	14	14	21
MEXICO	21	14	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	28	21	21	14	14	7*	7*	7	14	14	14*	21
PUERTO RICO	21	14	14	7	-	-	7	14	21	28	28	28
SOUTH AFRICA	21	14	7	7	7	7	7	14	214	21.	21.	21
U. S. S. R.	7*	7.	7	7	7	7*	7*	14	140	14	14	7*
EAST COAST	21	14	14	70	7 a	7	7	14	21	21	21.	21.

Very difficult circuit this hour.

* Next higher frequency may be useful this hour.

Good: 1-5, 7-17, 19-22, 26-31

Fair: 23, 25 Poor: 6, 18, 24

VHP DX Likely: 6, 13, 14

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New Products and Books



Eico 711

E.co's newest communications product is their 711 Space Ranger Short Wave Communications Receiver. It covers .55 to 30 MHz with a BFO, bandspread, S-meter. Its cabinet is attractive enough for the living room. In kit form, the 711 is \$49.95; wired, it's \$69.95. You can get more information from Eico, 131-01 39th Ave., Flushing, N. Y.

Denson Catalog

A surplus catalog to really make you drool is the new, 160-page catalog from Denson Electronics Corporation. Al Denson, W1BYX has spent a tremendous amount of time photographing, listing and organizing his stock and the results are very impressive. Al specializes in television equipment, but the catalog contains surplus and used equipment of every description. Of special interest to the TV ham is a complete bibliography of articles on ham TV and many reprints of articles on TV in the catalog. The catalog costs 50c; it's worth far more than that for the reference data alone. Denson Electronics, P. O. Box 85, Rockville.

Oscilloscope Measuring Techniques

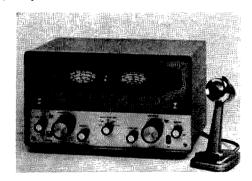
The serious electronics experimenter knows that an oscilloscope is the most valuable piece of equipment available for testing. However, few hams take full advantage of their scopes. An excellent book about scopes and their uses is Oscilloscope Measuring Technicques by J. Czech. The book is the English edition of a book published in German by Philips, and it is very complete. The first 250 pages of the book are devoted to scope circuits and construction, the next 120 pages to general measuring techniques, the next 170 to specific techniques and the last 50 pages to scope photography and projection. The book costs \$15.80 and is available from Springer-Verlag, 175 Fifth Ave., New York, N.Y. 10010.

Low Cost VHF Antennas

A new line of low cost VHF "Space-Saver" antennas for 120-480 is being manufactured by International Crystal Mfg. Co. The antennas feature full performance, solid molded bases, ease of installation. Mobile and fixed base units include a vertical mobile for \$5.25, vertical ground plane with universal mount \$8.50 or with pipe mount \$10.95, dipole with pipe mount \$11.95, and the attic or base antenna with universal mount for \$6.95. Special coax cable kits for use with antennas are priced at \$3.95 and \$4.95. For complete information write International Crystal Mfg. Co., Inc., 18 North Lee, Oklahoma City, Oklahoma 73102.

RCA Receiving Tube Manual

The new edition of the RCA Receiving Tube Manual (RC-25) contains over 600 pages of information on electron tubes and their uses. The first 100 pages contains a wealth of data on general characteristics of tubes and how they should be used. The next 400 pages lists all receiving tubes made by RCA—virtually all receiving tubes—with all of their characteristics. The last section of the book contains many applications of tubes, with specific circuits and description of how they work. The book is a tremendous buy at \$1.25. Buy at your dealer, or order from RCA Commercial Engineering, Harrison, N. J. 07029.



Hammarlund HQ-205

The new Hammarlund HQ-205 is a general coverage receiver with a built-in 5 watt 10 meter or CB transmitter. Electrical bandspread is on 80-10 meters as well as CB. The receiver tunes .540-30 MHz. It includes a variable BFO, Q multiplier, NL and S meter. Price is \$259.00. You can get more information from Hammarlund Amateur Products, 73-88 Hammarlund Drive, Mars Hill, N. C. 28754.



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5. 1b. \$3.50.

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G and G Catalog

A new 24-page Catalog of Communications Electronic Equipment has been published by G & G Radio Supply Company, 75-77 Leonard St., New York, N. Y. 10013. The catalog, which is fully isllustrated and contains complete technical information, covers military surplus receivers, transmitters, power supplies, test sets and associated equipment, including dynamotors, tranmitting crystals, special purpose tubes and headsets. Copies are available from G & G Radio Supply Company for 25c refundable with first order.

Amperex Components Catalog

Amperex makes some very nice electronics components that aren't well known to most readers of 73 because they aren't handled by any of the distributors we usually buy from. However, they've put out a catalog that should be of interest to all designers and buyers for manufacturing companies. The catalog contains condensed listings of electrolytic, foil, ceramic and variable capacitors, linear and non-linear resistors, speakers and knobs. Copies may be obtained by writing on company letterhead to Amperex Component Division, Hicksville, N. Y. 11802,

Directory of Electronic Circuits

In his new book Matthew Mandl presents a unique and valuable took for amateurs, technicians and engineers; a very comprehensive directory of more than 150 circuits used in all fields of electronics. Each of these circuits is completely analyzed in a very readable manner, and typical circuit values are provided along with the equations and formulas that describe their operation. To provide a more useful tool, the author has grouped the circuits into general categories and provided a detailed cross-reference system throughout the book. While the emphasis has been placed on transistorized circuits, vacuum tube circuits are detailed for comparison purposes or where they find a special application. Some of the categories of circuits are amplifiers, modulation and demodulation circuitry, filters, attenuators and pads, oscillators, power control and supplies and pulse circuits. In addition, a handy glossary of the most frequently encountered technical words is provided along with an appendix containing unit values, conversion factors, color codes and other useful electronic information. In all, this book is a very useful text that should be of interest to old timer and novice alike. \$10.00 from your bookstore or write to Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632.

FET Projects

The latest book in Motorola's line of HEP publications in Field Effect Transistor Projects. It is a step-by-step instruction manual on projects that can be made with Motorola HEP FET's and other components. The projects are a vibrato for electronic musical instruments, an audio mixer, a timer, a crystal oscillator (such as a 100 kHz calibrator), and hi-fi preamplifier, and a dc voltmeter. The book also includes a short section on FET theory and construction practices. Complete building instructions are given for each project, including layouts.

Quaker Electronics Tech Manuals

Quaker Electronics has published a catalog of technical manuals they have for sale. The catalog also lists a number of very common pieces of surplus for which they have schematics. You can get the catalog for 25c from Quaker Electronics, P. O. Box 215, Hunlock Creek, Pennsylvania.



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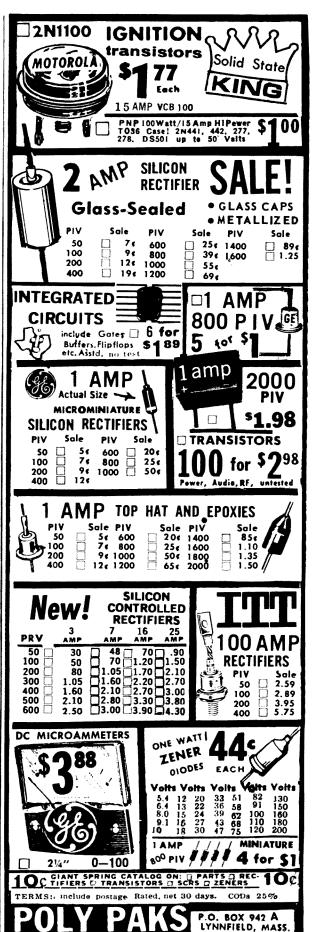
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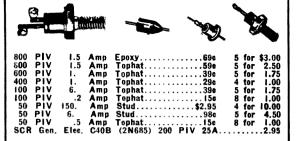
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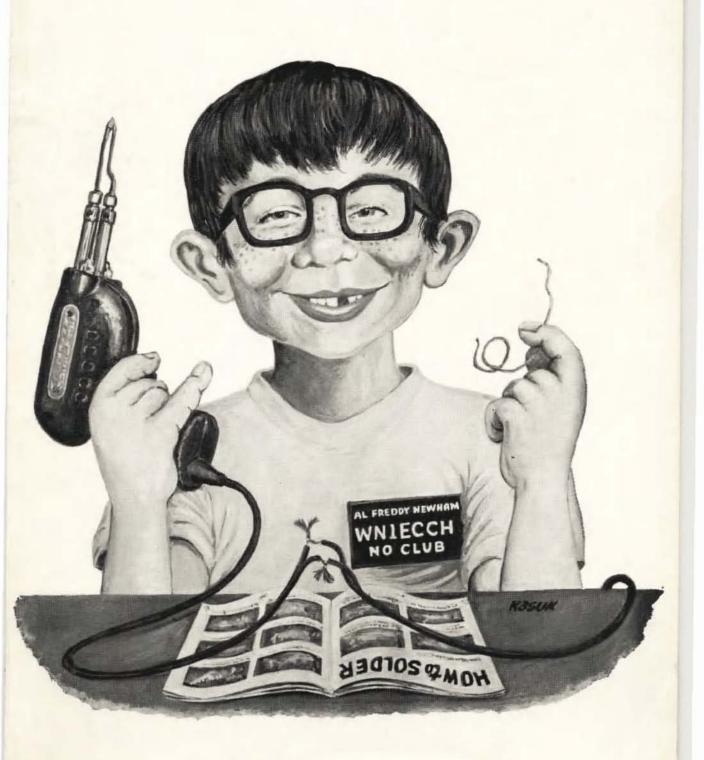


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73 Magazine

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April 1967

Vol. XLVI, No. 4

Cover by Wayne Pierce K3SUK

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de W2NSD|1

never say die

CB

The CB licenses are now down to about 800,000 and the FCC reports that renewals are running about 12%. It would appear that the tide has turned and that the CB channels are changing from hobby use to business, as was originally intended by the FCC.

DXing

In answering the OSL's to my operations at FO8AS, VR2FD, FK8BG, 5W1AZ, 9N1MM and other exotica I have been surprised, to be polite about it, by the number of cards coming in with time and date in local terms instead of GMT. I'll be blunt: this is STUPID. I work four or five stations a minute and when I get a card in Mountain Standard Time I have to either make the conversion to GMT or else start looking through the logs until I find the contact. Perhaps one third of the cards have the time and date exactly right . . . and one third have the right date and the time within fifteen minutes (about 100 or so contacts to look through in the log). One third are way off with the date wrong and time either very wrong or else in local time. About 5% I just couldn't locate in the logs at all. Come on fellows, use correct GMT time and date.

ARRL

Perhaps my approach to the League has been a bit critical, but implicit in this was a constructive intent. I do believe that we should have an organization to represent the amateurs. Many amateurs firmly believe that this is the present function of the League. Unfortunately this is a delusion. The League certainly could assume this function and I think that it would be very advantageous to amateur radio if the mem-

bers of the ARRL made every effort to achieve this end.

You see, right now amateur radio has absolutely no representative organization. We stand just about alone as a major user of the radio spectrum without any such official representation. The other vested interests see to it that they have a good loud voice in Washington and they are right in there putting on the pressure whenever anything comes up that could help or hurt their groups. They work with the government agencies, with the administration, and with Congress to make sure that everyone knows their side of things and that they get the best shake.

A few ARRL directors have for years been trying in every way they could to get the League to open a small office in Washington and set up a lobby for amateur radio. No adequate reason has ever been given for killing off these attempts. The directors I have talked with about it felt that the main reason was that the HQ top brass didn't want to take any chances on the seat of power leaving them . . . and they didn't want to leave the nice green fields of Connecticut for the concrete of Washington.

They are probably right. Once something is started in Washington it is bound to take over for that is where the action is . . . that is where things happen. I suspect that if our ARRL were centered in Washington and had the ear of the FCC, the administration, and Congress that ham radio would not be in the terrible fix it is today. One of our country's most valuable resources is amateur radio and our government and Congress should be constantly made aware of this.

Loyal ARRL members would do well to ask their directors to press for representa-

(Continued on page 110)

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Editors

Ramblings

Editing a magazine is a peculiar occupation at best, and editing this magazine is probably even more peculiar than most. It often seems like a big, unreal game. However, even though the game is a hectic and nervewracking one at times, I must admit that I've enjoyed most of the last three years while I've been at 73, and particularly the last year or so while I've been editor. I've enjoyed meeting many interesting peopleauthors, readers and advertisers-and have learned much about electronics, publishing and ham radio. So it's with mixed feelings that I announce that this is the last issue of 73 that I will edit. I've tried to improve 73, but know there's far more that can be done. That's why I'm happy that the new editor will be Jim Fisk W1DTY, ex-WA6BSO. KR6JF, K4RPW, K3CPJ, and KA9MF. Jim is well known to all 73 readers for his many articles and books. He is a DX'er (SSB and CW) as well as an avid experimenter, home-constructor and UHF-VHF fan. Jim is highly competent and I know that 73 will improve steadily with him in charge.

As for me, I'm joining General Radio Company in Concord, Massachusetts, but hope to keep my hand in ham radio publishing by editing the new 73 column. "What's New for You?" and by writing. Until then.

73 Paul Franson WA1CCH



Jim Fisk WIDTY



Al Freddy Newham WNIECCH Flagrant, New Hampshire

The Super Duper Super

When my ticket arrived from the FCC, I was really up against it—I had to have a good receiver. I was all set in the transmitter department; one of my good buddies from across town donated a slick crystal controlled job with a pair of 199's in the final. I couldn't come up with any homebrew receivers that matched the goodies I had in the junk box after searching through the current ham magazines, so I decided to use a little ingenuity and the parts that I had on hand.

I'll have to admit that this design is not completely my own; it evolved from several

of the articles that I read before starting this project. Here again my good buddy was a big help—he gave me a whole carload of ham literature. After drooling over the Marconi loose couplers, Grebe receivers and REL transmitter kits in the ads, I did a lot of reading about receivers. With the helpful hints of these articles under my belt, and a lot of sweat over the kitchen table, I came up with the two tube super duper super shown here. It may not be quite up to par with the Colland's Super Century or the Crutchcrafter's SD-150, but it runs a very close second. And besides, it didn't cost

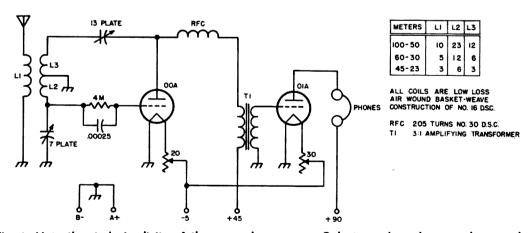
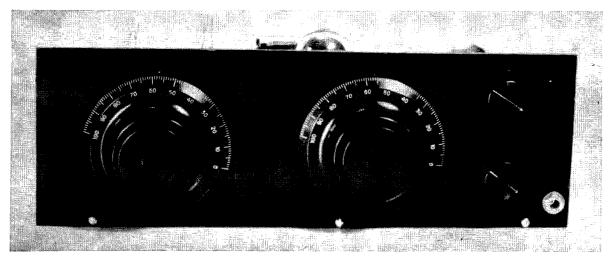


Fig. 1. Note the stark simplicity of the super duper super. Only two tubes, three condensers, three resistors, an amplifying transformer and some wire are required. For details on how to wind the coils and the rf choke, consult the text.

6 73 MAGAZINE



The super duper super. The large dial to the left is the rf tuning control; the large dial to the right controls regeneration. For best results these two knobs must be worked together. The two knobs on the far right control the amplification of the detector and audio stages.

1/10 as much.

The basic plan I had in mind was to come up with a receiver that was simple to build and use and that could be duplicated by other hams with a junk box like mine. I opined that there must be a lot of fellows in the same boat as me—lots of parts but no circuit that they'll fit. And then too, I didn't have a whole lot of goodies; in fact, at times I wondered if I would be able to come up with a workable receiver with the things that I had. As you can see from the schematic, this little job only uses two tubes, three condensers, three resistors, one transformer and some wire; you can't get much simpler than that!

Basically the super duper super consists of a regenerative detector and an audio amplifier. I experimented with various methods of controlling the regeneration in the detector, but finally decided that the Weagent capacitive regeneration control gave the best results. The circuit seemed to be the easiest to tune and didn't move too far off frequency when I pulled my hand away from the dial.

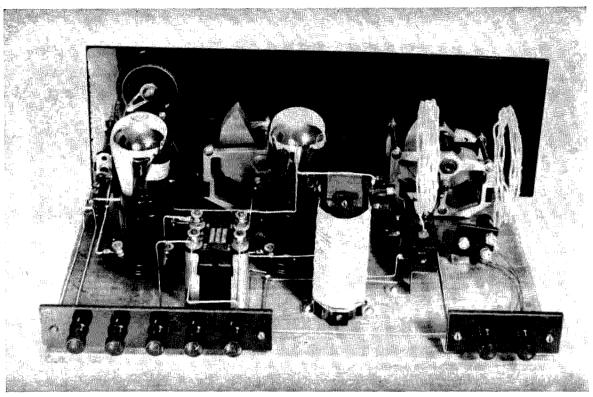
I heard someone say once that much of a receving set's performance depends upon the correct choice of the grid leak and my experimenting bears this out. It must be quiet and must have a resistance of four or five megs for CW work. For phone work (after I get my general ticket), values as low as 1.5 megs seem to work quite well. The grid condenser was also determined by cut and try. I found that a grid condenser

capacity of a micromicrofarad per meter is not too far wrong for the 00A detector. I didn't use this value however because all I had in the junk box was a 0.00025 unit.

The tuning condensers are just as they came out of the junk box. There are no markings on them so I don't know what their capacity is, but the rf condenser has 7 plates and the regeneration control has 13. Actually, almost anything will work here; all you'll have to do is change the number of turns in the coils.

And the coils-they are the most unique part of this whole design. After scanning the ads and the ill gotten gains of my broken piggy bank, I decided that I'd have to use air wound coils and forego the nicety of coil forms. From what I have heard since, this was probably a good decision; most of the bakelite and hard rubber forms are pretty lossy on the short waves. I managed to glom on to a couple of rolls of D.S.C. (double silk covered to the uninitiated) annunciator wire and decided to use that for the coils. By evenly spacing 13 large finishing nails around the perimeter of a 3 inch circle, I formed a jig for winding my basketweave coils. By weaving the wire around the circle of nails, I ended up with a strong coil that was easy to handle. A raid on mother's sewing basket provided some heavy cotton thread to tie the turns together.

To cover the various wavelengths that I am interested in I had to have some method of plugging in different coils. A home made plug in coil arrangement was made by mounting banana plugs and jacks on a



The working parts of the super duper super. The antenna coil is on the far right with the rf and tickler coil to the left. The large upright object in the foreground is the Newham special rf choke. The two terminal strips on the back edge of the apple crate provide connections to the batteries and antenna. Note the geometric layout of the wiring which contributes so much to the set's performance.

couple of bakelite strips. At first I laid out the strips nice and even with the center tap right in the center of the jack bar, but this led to some quick shuffling when changing coils—you couldn't tell when the tickler was plugged into the right two holes. A modification moved the center tap a little off center so I didn't have to count turns every time I changed wavelengths.

The antenna coil was mounted on another chunk of bakelite which pivots on a brass angle support. With this arrangement I can vary the coupling between the antenna and rf coil for best results. This is a little ticklish until you get used to it because when you put your hand over the panel to move the antenna coil, everything changes frequency. However, with a little practice you can almost tell ahead of time which way the tuning is going to go.

The rf choke was a pure stroke of genius if I do say so myself. The first efforts resulted in a whole bunch of dead spots in the tuning range. That is, spots where the detector refuses to give out with nary a whistle. I don't quite understand all the

ramifications of these dead spots, but I'm working on it. Anyway, the most suitable rf choke I found consisted of 205 turns of number 30 S.S.C. (single silk covered) lump wound on a home made form. Losses are apparently not too important in an rf choke so I made a form by screwing four four inch strips of bakelite to one inch squares of orange crate wood.

After building the complete receiver on the kitchen table, I had to come up with some more portable way of building the finished product. Mother didn't take too lightly to the screw holes and soldering iron burns in the table top, and besides, how was I going to get the table into my shack? The family had to have someplace to eat. Except for a little spilled soup in one of the condensers, the super duper super made it through this crucial period with flying colors. I can't say the same for its originator—for a while I thought ham radio would be banned forever from the Newham house-hold.

A couple of raids on the city dump yielded the rest of the material I needed to build

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73 Magazine

Peterborough, N.H. 03458

the super duper super into one compact table top package. The side of an old apple crate served as the bottom and a piece of bakelite from an old Army surplus aeroplane spark transmitter (Mark II) was used for the front panel. All the parts were carefully laid out on the apple crate and then wired together with solid number 16 bus wire. I took great care to make sure that all the wires were parallel to the sides of the apple crate and to make sharp 90 degree bends when turns were necessary. This layout works pretty well down to wave-lengths of 23 meters, but below that performance is not so hot. My good buddy said something about lead length? I don't understand this at all because everyone knows that the shortest distance between two points is a straight line, and all my wires are perfectly straight. I am usually a pretty modest fellow, but the wiring job is magnificant in its geometric beauty, even if it doesn't work on the ultra highs below 20 meters.

The super duper super is a real dream to use. It only has four controls and only two of these have to be tuned at any one time. It only takes about eleventeen hours to get the proper technique down pat. Almost

everyone who has had a chance to use the super duper super has been surprised at its performance. It doesn't surprise me at all, I knew it would work all along. After all, it is based on many proven designs. It has surprised some hams so much that they went away mumbling to themselves. Naturally all this pleases me very much because this was my very first ham project.

Now that I have been on the air several months with my twin 199's and super duper super, the junk box is starting to fill up again. I now have lots of tubes, amplifying transformers, condensers and even a couple of little doodads marked 2N384. My good buddy claims that these miniscule little gadgets will replace the tubes in the super duper super, but I don't hardly see how-they only have three connections. Anyway, I'm working on it and I'll have a full report for all you readers in a subsequent article. ... WN1ECCH

*"A One Control Neutrodyne," J. MaLaughlin, QST, August 1924.

"Short Wave, Plug-In-Coil, Receiver Design," F. Marco, QST, February 1926. "Short Wave Receiving Sets," L. Hatry, QST,

July 1926.
"A Simple 1750-and 3500 kc Receiver," B. Dudley, QST, November 1929.

A Toroidal VFO

Gene has made an excellent VFO using a toroidal inductor. This VFO has many interesting construction ideas.

Many advantages can be gained by using toroids in amateur radio equipment. Their small size and high-Q head the list of reasons why they are seeing more and more applications today.

No longer is it necessary to use a four or six inch square box to house the big ceramic coil in the home-made VFO. No longer does the circuit stop oscillating when we attempt to reduce the box size, now that we have toroids. One of these %-inch-diameter gems can be mounted right on a printed circuit board along with the transistors and capacitors which make up a VFO circuit.

A transistorized VFO employing a toroid coil was described by Jo Emmet Jennings W6EI in 1963. Del Crowell, K6RIL sparked current enthusiasm with this recent excellent article from which our circuit (and several cores) were borrowed. In this

Circuit

A conventional Clapp oscillator is used, feeding an emitter-follower buffer stage (Fig. 1.) High frequency NPN transistors such as the 2N697 are used for the oscillator and buffer stages. Temperature compensation is provided by the 75 pF NPO type ceramic capacitor. The relative values of this capacitor and the 100 pF silver mica capacitor may be varied experimentally to provide flexibility in achieving optimum compensation.

An rf probe and vacuum tube voltmeter are indispensable when substituting transistors and making circuit adjustments for optimum output. Approximately 0.3 to 0.5 volts rf should be measured at the emitter of

²A Stable VFO or VHF or HF-73 Magazine, November, 1966.

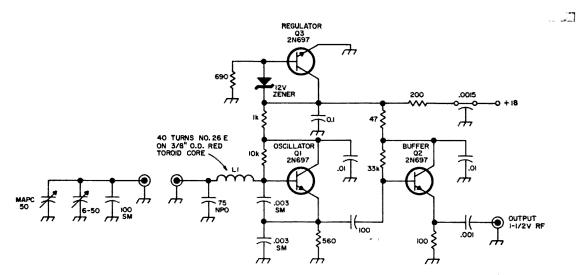
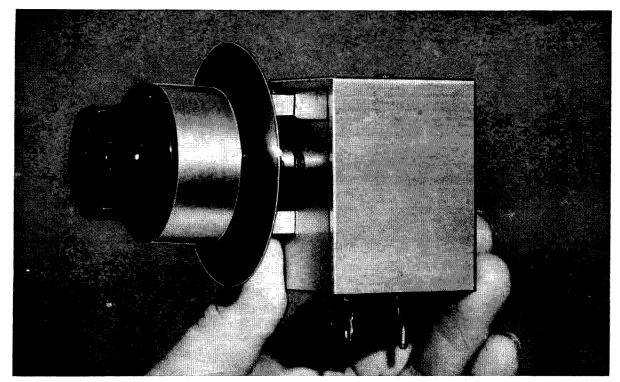


Fig. 1. Schematic of the VFO and power supply. Regulation is provided for both the oscillator and buffer. If more rf output is required, a tuned circuit (toroid, of course) can be installed in the emitter of Q2 in lieu of the 100 ohm resistor.

article is described a practical approach to the construction of a very compact and dependable VFO. The mechanical work required to fabricate the aluminum housing can be done with the simplest hand tools available in most ham workshops.

¹The Transistor Radio Handbook—Editors & Engineers Ltd.



The completed VFO with dial ready for calibration. One screw holds the cover in place. Trimmer capacitor and feed-throughs are used to secure the VFO to a chassis.

Q1. Decreasing the 560 ohm emitter resistor will increase the output up to 1½ to 2 volts whereupon oscillation will stop. The oscillator Q1 should be operated at the lowest emitter current consistent with obtaining approximately 1½ volts output at the emitter for Q2.

The regulator transistor, Q3 is an audio type NPN in a shunt regulator configuration. In the author's circuit, a 2N697 rf transistor was used because it was available. The zener diode clamps the base-to-collector voltage of Q3 to the value selected for VFO operation; in this case 12 volts. This diode may be of the inexpensive ¼ to 1 watt variety. Power for the VFO was obtained from a 6.3 volt transformer and a conventional voltage doubler circuit which provides a peak voltage of about 18 volts.

This VFO configuration may be used at any frequency from 1 to 10 MHz by selecting proper values for LI and its associated frequency determining capacitors. However, in the author's application, the frequency range of 3.5 to 3.65 MHz was required for doubling to the 40 and 20 meter bands.

Assembly

The various parts of the VFO are shown

in the photos. Four #4-40 screws hold the component board in place. The piston-type trimmer capacitor to the right is a Cambridge Thermionic Corp. CS6-50. It is externally adjustable and is used for band setting as well as for securing the VFO housing to a chassis. Positive 18 volts enters via the feed-through capacitor. Centralab Type FT-1500, which aids in mounting the VFO, as does the rf bushing, USECO #1433, to the left in the photograph.

A frequency spread of 150 kHz is achieved with a Hammerlund Type MAPC-50 tuning capacitor. The type capacitor having a ¼ inch shaft extension should be used.

Component Board

A phenolic or glass-epoxy board, 1/16 inch thick is used to mount the components. Fig. 3 shows the position and identification of the parts. In the VFO illustrated, a prepunched phenolic board was employed. Transistor sockets are used to provide greater flexibility in experimenting with different transistors. No deterioration in frequency stability was experienced when using sockets for the oscillator stage due to the "swamping effect" of the large 3000 pF silver mica voltage dividing capacitors.

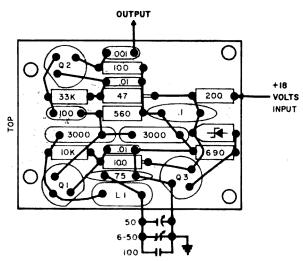
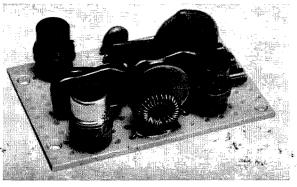


Fig. 2. Component identification is shown here. Because of the small size of the assembly, component leads may be simply bent over and used as indicated, instead of a printed circuit.

Housing

The objective of our VFO design was small size and simple mounting. For these reasons, a special housing had to be built because no commercial box or chassis was found suitable. The scrap pile of a local window glass shop provided rectangular aluminum tubing measuring 1-¾ inches by 4 inches outside. Two "U" shaped pieces were cut from the rectangular tubing so that they precisely "nest" together. One #4-40 machine screw holds the cover in place.

Brackets for mounting the component

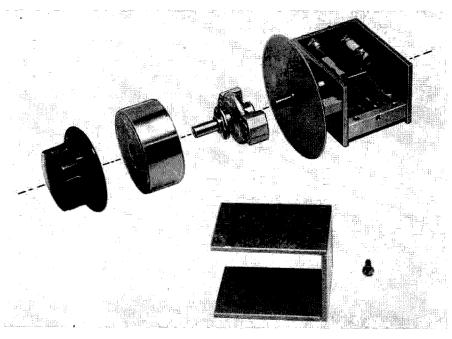


The VFO component board. Pre-punched phenolic material is convenient for the amateur constructor, however, a printed circuit board would improve appearances and provide a little more freedom in making the most desirable component spacing.

board were cut from aluminum scraps and glued in place using epoxy cement. While epoxy provides a valuable fabrication technique, one should not depend on cemented joints for electrical connections. The ground lead from the component board should be brought out and soldered directly to the tuning capacitor terminal as well as to a lug under the piston-type trimmer.

Tune Up

When using a toroid coil core it is impossible to use a grid dip meter in the conventional manner for verifying the frequency of a tuned circuit. This is because the flux of the coil is almost entirely contained within the closed core. Therefore, prior to ce-



Exploded view of the VFO and dial drive mechanism. Two Jackson Bros. planetary-vernier drives provide a 36:1 ratio. Leads to the tuning capacitor and feed-throughs are soldered after installing the component board.

menting the coil in place on the component board, it should be suspended by its leads which are left about 1½ inches long. These leads and the coil form a loop to which the grid-dipper may then be coupled.

After verifying the proper frequency of the tuned circuit, power should be applied with the regulator transistor Q3 only in place. Positive 12 volts dc will be measured at the collector of Q3. A check of the regulator under load can then be made by temporarily placing a 150 ohm resistor between the emitter and collector terminals of the buffer socket. This resistor, together with the 47 and 100 ohm resistors in the circuit, will present a total load of 300 ohms which will draw 40 milliamperes from the regulator, simulating about 100% overload conditions. The regulated 12 volts should show no discernable change under these conditions.

On the Air Tests

Excellent signal tone and stability are obtained from this VFO. The construction techniques used provide maximum immunity from mechanical shock and electrical transients. Long term stability is also achieved by negligible component heating and superior dissipation afforded by the sturdy housing.

A new era of VFO refinement is made possible by the toroid coil. The amateur constructor is well advised to include toroids in his present day projects.

. . . W4BRS

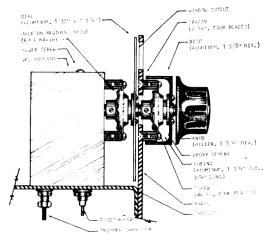


Fig. 3. Cross-section of dial drive mechanism. This arrangement is used in several commercial SSB transceivers. Spacers 7/16 inch long and taped for #4-40 screws hold the drives in place. The aluminum knob nearest the panel provides fast rotation (6:1 ratio) while the conventional knob provides slow speed (36:1 ratio).



Transceiver CW Filter and Monitor

An inexpensive and simple transistorized accessory unit for improving the CW performance of any transceiver.

Just about every transceiver on the market still lacks adequate built-in provisions for CW work—that is, a CW keying monitor and sharper IF or audio selectivity for CW. The author previously built a tube-type accessory unit that could be used with almost any transceiver to provide these functions. However, being an "outboard" unit it was not suited for use in mobile or portable applications. What was needed was a minaturized version which could be tucked away inside a transceiver case.

Circuit

After some experimentation, the author came up with the circuit shown in Fig. 1. Transistors Q1, Q2 and Q3 comprise a so-called "active" audio filter which allows a good deal of selectivity to be obtained by

only RC circuitry. Essentially Q1, and the network in its base circuit make up a low-pass audio filter while Q3 with its network comprise a high-pass filter. The combination of the two circuits produces the selectivity characteristics shown in Fig. 2. The filter can be used between any two low-level, moderate to high impedance points in a receiver audio circuit.

The dashed line in Fig. 2 indicates the ideal if selectivity which a 2 kHz mechanical filter might provide. As can be seen the audio selectivity provided by the three stage "active" filter is a considerable improvement, at moderate attenuation levels, for CW work. If the graph were expanded to cover higher attenuations than 25 dB, it would be seen that the skirts of the active filter flare out beyond those of the mechanical filter. So, while the active filter will by no means pro-

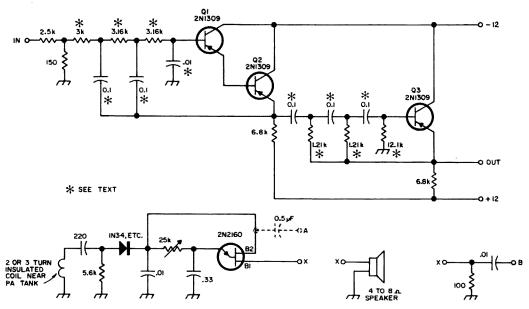


Fig. 1. Filter and monitor circuit which may be used with an SSB transceiver for excellent CW hamming. The -12 and +12 voltages may be obtained from any well-filtered point in the transceiver.

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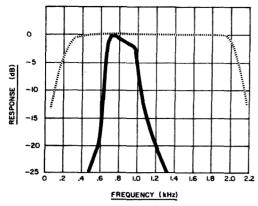


Fig. 2. Approximate frequency response of the filter shown in Fig. 1.

vide the same steep skirted selectivity of a narrow crystal lattice or mechanical filter, it does provide enough selectivity, in a very simple form, for effective CW work.

The CW monitor is rf actuated and uses a unijunction transistor in a relaxation type oscillator circuit. The 25 k potentiometer is used as a tone control. A 10 k fixed resistor could be substituted for further simplicity. Output for headphones can be taken from either points A or B. If the outputs from the filter and monitor are parallel to be used with a pair of headphones, some experimentation will be necessary with the coupling condensers at points A or B to find a value which gives sufficient output level without loading the filter unduly (depending on headphone impedance).

The tone from the monitor, like any relaxation oscillator, is hardly very easy on the ears but satisfactory for the occasional CW user. The CW monitor shown in Fig. 3 is suggested if a smoother note is desired. The 12 volts necessary to power the circuit could be obtained from a RF pickup coil and rectifier, as with the unijunction type monitor, or from some point in the transmitter which provides 9 to 12 volts under key-down condition (across the cathode resistor of a rf stage in a grid-block keyed transmitter, for instance.)

Construction

Construction is simple and inexpensive. No adjustments, other than the tone control, are necessary.

How compactly the unit can be constructed depends solely upon the builder's ability to compact components on a perforated circuit board. Except, of course, for the rf pickup

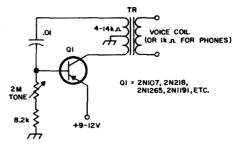


Fig. 3. Another tone oscillator which may be substituted for the one shown in Fig. 1.

coil which must be placed by the PA tank coil, the unit will fit on a 2" x 2" perforated board.

All the transistors used are of the \$1 variety. The only components that are critical are the resistors and condensers starred in Fig. 1. If the selectivity characteristics of the filter are to be attained, the resistors must be of the 1% tolerance variety. The condensers must also be matched as closely as possible using, for example, a capacitance bridge or meter. If "off-the-shelf" 10% tolerance resistors and capacitors are used, performance will likely prove disappointing.

A great many, if not almost all, of the components necessary can be obtained by buying several of the computer boards available at three or four per dollar from various supply houses.

Usage

The unit can be wired into a transceiver so that it can be switched in and out of audio chain in the receiver. A still simpler, "no-holes" approach for those who only use headphones on CW and who have a medium or high impedance headphone jack on their transceiver is to replace the headphones jack with a multiple circuit unit, such as shown in Fig. 4. Plugging the headphones in the jack disables the loudspeaker and the filter and monitor are in the circuit ready for CW operation.

... W1DCG

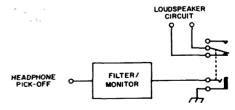


Fig. 4. A phone jack with additional switching circuit may be substituted for the regular phone jack.

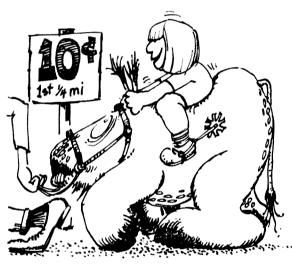
COKERISMS DEPT.

dreadful ham clichés

(Bad Dreams at K3SUK)



ZERO Beating



Riding the GAIN



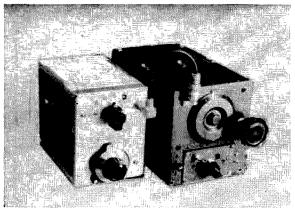
Checking the BAND



Dipping the FINAL



Chasing DX



WIOOP's Converter Converter and modified BC command set.

The Converter Converter

Here's an intermediate converter for use between a UHF converter and a receiver tuning the broadcast band. It uses an inexpensive field effect transistor as a mixer for simplicity and excellent resistance to overloading.

A few weeks back I picked up the BC-band version of a command set at one of the local auctions. Now this is one of the nicer (and rarer) of the ARC-5 or 274-N series. It tunes 0.52 to 1.52 something or others (as this is about 23 years old, I guess they are

Fig. 1. Simple version of the Converter Converter by WIOOP. This is designed for covering 14.0-14.4 MHz, with 1.0-1.4 MHz output.

megacycles) with divisions every ten kHz and about thirty turns of the knob to go the range. The intermediate frequency is 239 kHz and it has the same sort of variable-coupling cans that are used in the BC453, so sharpness is easily obtained.

With such admirable selectivity and bandspread, it seemed a shame that it couldn't be used to run one or more of my UHF converters into, so as to have a permanent setup for scanning 431.95 to 432.4, for instance, while working or trying to work another band. While it is hard to get any image rejection with a second if of two or three hundred kilohertz, there should be no trouble in doing it with the receiver tuning 1 to 1.5 MHz. This converter was made for that purpose. My six, two and 432 converters have a nominal intermediate frequency of 14 MHz, while that for 220 tunes 16 MHz down for 220 up. By using crystals providing beating frequencies of 13 and 17 MHz the ARC-5 tunes forward on all bands, which simplifies the mental arithmetic a slew. (A slew is an archaic unit between three and ten dB.)

The oscillator uses surplus crystals at half frequency because I and Meshna had them. The mixer has an FET, since it made the whole business simpler. The 2N3819 (roughly the same as the TI-S34) can be thought of as a super-6CW4, or maybe a super-6CB6 with poor screening. It is quiet, it oscillates nicely at three hundred megohertz with only the leads to a twenty meter tank

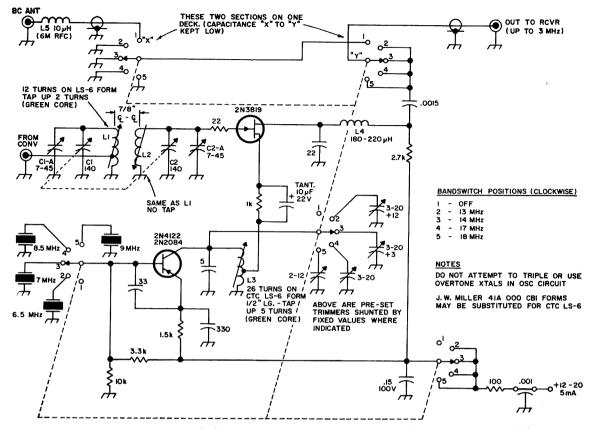


Fig. 2. More complete version of the Converter Converter, with band switching. Shield the quartz crystals if you live within 10 miles of a TV station.

circuit, and the gain, while less than overwhelming, is adequate. According to the manufacturers specifications, the currents and voltages could be almost anything, but that is no problem for the man who is making only one gadget, because the values can be tailored to the particular FET. Suppose we set up with a six to twelve volt battery on the drain (plate) and gate and source grounded to the negative terminal. We measure a current in the drain lead-it might be anything from 2 to 20 mA. For mixer operation, the FET should be turned all the way on only a bit of the time, and if we are trying to operate as a squarelaw mixer the gate voltage should swing from cutoff up to zero bias with oscillator drive, giving an average current about 40 percent of the zero-bias value, with drive, and a quiescent current 25 percent of the zero bias value. We can find the proper operating point by measuring the bias voltage required for one fourth the zero bias current, (no signal) and then setting things up so the source (cathode) resistor has that

*Measure through a good rf choke to avoid changing the amount of injection.

much voltage across it when the oscillator is driving the mixer. My 2N3819 had 4.5 mA at zero bias. It also had UHF oscillations in the circuit, so I put that 22-ohm resistor in the gate lead . . . anything ten to fifty ohms would probably do.

With the second preselector tank shorted (I jammed a solder lug into C2) the current with oscillator going was 1.6 mA, but with

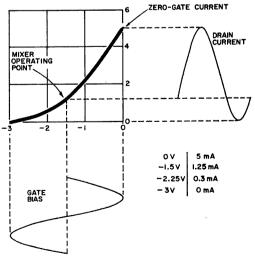


Fig. 3. Operation of the FET mixer.

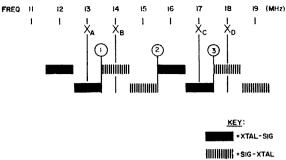


Fig. 4. Coverage of the Converter Converter. If the receiver tunes 0.50-1.50 MHz, there is no gap in coverage. If the receiver tunes 0.52-1.52 MHz, there is a 40 kHz gap at (1) and (3) and overlap at (2). Of course, if $X_{\rm B}$ and $X_{\rm D}$ are 40 kHz low, there is no gap. Coverage is 11.5-19.5 MHz. The coverage W100P wanted was 12-12.4, 14-14.4 and 16-15.5 MHz (the last backwards, for a 220 MHz converter with 236 MHz local oscillator.)

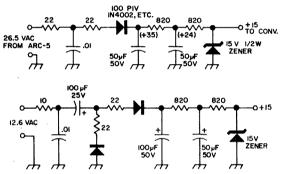


Fig. 5. Two suggested power supplies. The top one operates from 26.5 V ac from the command set and is the one WIOOP uses. The bottom one operates from 12.6 V ac and is hypothetical. In both, the 22-ohm resistors help eliminate hum modulation and hash as well as furnishing protection for the diodes.

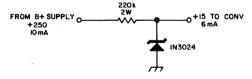
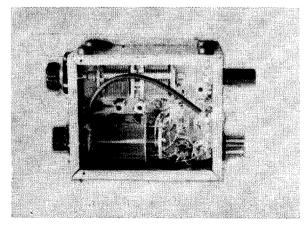


Fig. 6. You can get power for the converter from your receiver B+ supply. Important: the resistor is 22 k, not 220 k!



C2 unshorted the current could be changed from 1 to 2.2 mA by tuning the preselector around. When working, the preselector tuned 1 MHz above the oscillator gave me 1.7 mA, while tuning to the low side dropped the current to about 1.4 mA. The big variations were when the preselector was tuned only a few hundred kilohertz either side of oscillator frequency. 1 judged that bias and injection were about right.

I used a 10-µF tantalum bypass on the source resistor, on the theory that it would reduce crossmodulation if any were going to take place, but any value over a 0.1µF should work. I had a lot of the small tantalums on hand.

Tuneup: The oscillator section should be got going first, as it is used in setting up the mixer bias as above. The preselector circuits then should be made to track over the range desired. If a dual 140-pF capacitor is used, the tuning range can be about two to one in frequency; for more range, use a larger capacitor. Many of the commercial ham-band-only receivers have a similar scheme. (They cannot track the preselector with the if tuning because sometimes they are going in different directions!) No rf stage is used because of the gain provided by the UHF converter ahead, but the two coils are loosely coupled by being side by side (0.875 in or 2.215 cm center to center) with windings in the same direction and the top end of each coil hot. (With this polarity, a little capacitance coupling will add to the inductive coupling.) The two circuits have to tune the right range (or a little bit more, but no less) and should do it together, but they don't have to track with a dial or an oscillator.

I started with the slugs all the way out and went to minimum capacitance on the gang capacitor. Then using the trimmers, I put both coils at about 20 mHz. A piece of drill rod in the coil *not* being grid-dipped keeps things simple. Dip one, shift drill rod, dip other. Then to low end (11.5 mHz) and maximum capacitance put slugs where they need to be. Then, using signals from an antenna or from the dipper, you can peak the trimmers on a signal at the high end and peak the iron slugs on a low end signal once or twice and the job is done. The preselector action should be very obvious. Write down a few dial readings so you can hit them again in a hurry.

The idea is pretty much the same as

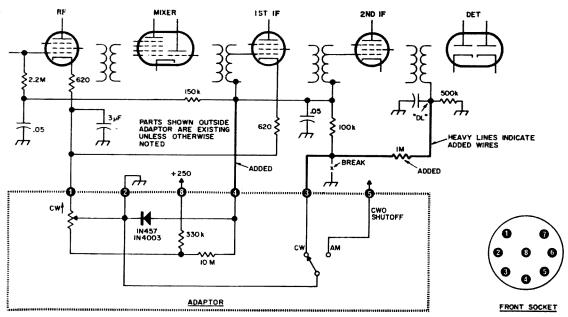


Fig. 7. Adding AGC and gain controls to the SCR-274N. The potentiometer is an Ohmite CB-2531, IRC-CTS Q14-120, Mallory U-28, RV4NAYSD253F or E. It has 25 k Ω total with about 2500 ohms to CW terminal at 50% rotation. The voltage on CCW terminal is low at low gain settings and about \pm 15 volts with the control more than half on. This means no ACG developed until -2 volts on DL. Putting the switch in the CW position puts things back to the original 274-N status. You have to use some ACG delay or there's not enough audio. Replace the antenna connector with a BNC or phono jack for converter use.

K1Q1M's "Crystal-Controlled Front End" in the February 66 issue, except that we don't use tubes. One word of caution: although I put the crystals outside the box (in sockets) I found that there was pickup from my rather local TV stations, curable by putting a shield over them. Therefore, I suggest putting the crystals inside the box. The input is a two-stage bandpass filter, the output is a low-pass filter (cuts off a bit over 3 mHz) and there is not any excuse for hash from TV signals, nor for TVI from the oscillator, if things are laid out correctly, and the power leads filtered.

Because the power drain is only about 5 mA, the juice could be stolen from the B-supply in many cases. (Be sure the regulator diode used is dependable!) The power supplies shown will work on twelve or twenty-four-volt filament windings. Without readjustment, it should be ok to use with any receiver tuning either the broadcast band or up to 3 mHz, for instance the 1.5 to 3 mHz Arc-5.

Later tests show that the \$1 Motorola MPF105 FET works very well in this circuit.

WIOOP

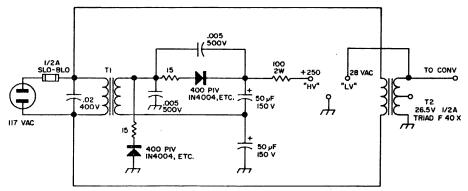


Fig. 8. Simple conversion power supply. T1 is a Lafayette isolation transformer XF or Triad N-51X (20 VA isolation transformer). Use the Triad back-

wards to keep B+ down. The 0.005 μ F capacitors and 15 ohm (not critical) resistors reduce hash in the BC band.

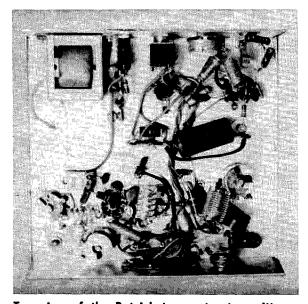
The Ratnick Twoer, Mark IV

A very simple two meter transmitter for local contacts

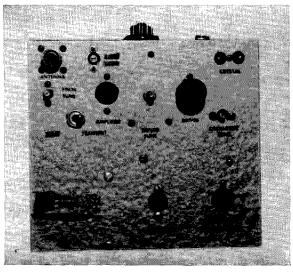
The Ratnick Twoer Mark IV is a simple two meter transmitter capable of a good signal with modulation percentage closely approaching 100%. As VHF transmitters go it is easy to duplicate. The circuit is straight forward and little trouble should be encountered as long as good VHF construction techniques are used. All rf carrying leads should be as short as humanly possible. The rule for bypassing is as follows: if you can't see the leads from the bypass capacitor you may consider it well bypassed. The lead arrangement of the audio section is not critical and any arrangement that appeals to the builder may be used.

The crystal oscillator is an electroncoupled type that oscillates on 8 MHz and has its output tuned to the third harmonic. It is very stable and may be driven by almost any high impedance VFO. The 24-MHz energy is tripled to 72 MHz in the second half of the 6U8. The final amplifier is a 5763 that doubles to 144 MHz. While this does not provide good efficiency it does simplify matters greatly in that the final does not have to be neutralized. The output is in the area of two watts and it is suggested that a high Q filter be employed in the output circuit to prevent the transfer of the spurious energy, i.e. TVI. Provision is made to key the final for CW though exceptional care should be taken to properly bypass the keyed cathode.

V3A and V3B are voltage amplifiers which are in turn fed into the 6AQ5 power amplifier. A neon indicator is used to show



Top view of the Ratnick two meter transmitter.



Bottom of the Ratnick two meter transmitter.

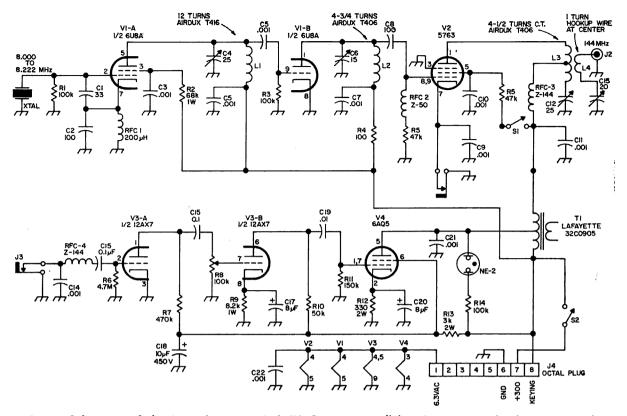


Fig. 1. Schematic of the Ratnick Twoer Mark IV. S2 is in parallel with an external relay connected to the "Keying" terminal.

the operator if he is modulating properly. If the exact values given for the tuned circuits are used no trouble should be encountered at all. The tuned circuits will just cover the frequency range needed and it should not be possible to tune them to the wrong harmonic. However, it would be wise to double check this with a grid dip meter. Insert a crystal in the socket and connect a dummy load to the transmitter through an SWR bridge. Simply tune for maximum output-it will be impossible to exceed the maximum plate dissipation of the tubes. Again double check the output of each stage with the dipper. Next plug in a microphone and slowly increase the audio gain control until the neon stays brightly lit as you talk. You will find that you have plenty of audio gain to spare. You are now ready to operate.

Results with this little peanut whistle (2 watts out) have been very gratifying and exciting. I have worked stations who said that when my signal approached the noise level the audio was still readable. While this rig is designed primarily for local ragchewing and nets it can give you quite a thrill DX'ing. With an eight element beam

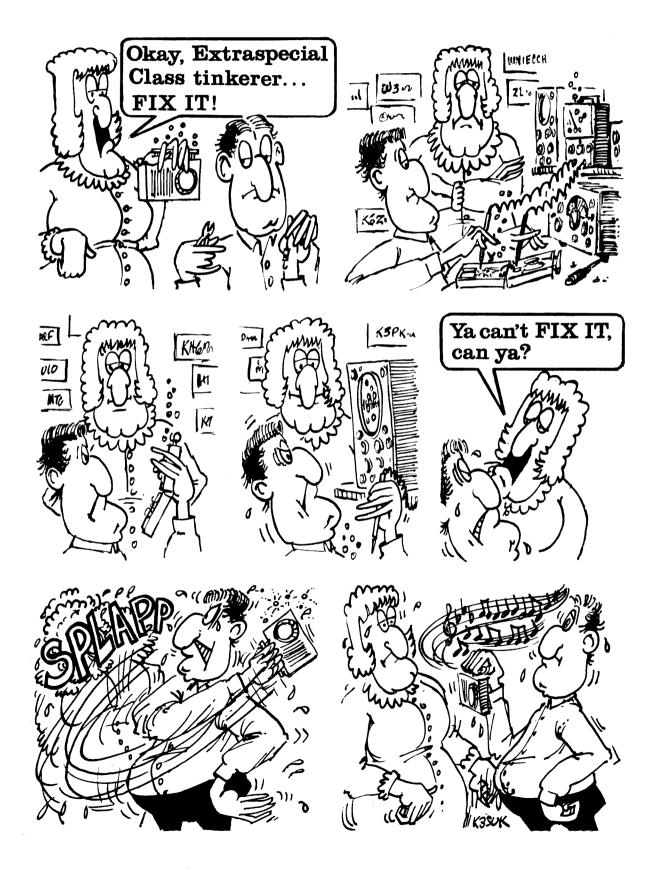
and a slight band opening I have worked New Hampshire, Massachusetts, Pennsylvania, Delaware, and Maryland without really trying and with crystal control. I also work the Windblowers in less time than many hundred watt boys. CW is also a thrill. One evening when the band was closed and no one was working anything I worked Chichester, N. H. with 5/1/9 signals. Not very strong but he was only 5/3/9 with his 400 watts. So, here's wishing you good luck and I'll see you on low power on two.



QSL cards from stations worked with the Ratnick transmitter and 829 linear from the Bronx.

DON MARTIN-WON'T-LIKE-THIS DEPT.

The CLINIC



Cardboarding--

An integrated system to record, develop, test, index and file ideas.

Do not read this if you are in a hurry because:

It could change your attitude toward the creative phase of electronics.

Consistent application of several rules could change your way of life. The rules are valid whether your interest is vocational or advocational.

You will be induced into exploring the most obscure recesses of your mind.

The man that has not mastered his mind is the master of nothing.

If you do not have an hour to study now, put this aside until you are ready but, as a reminder write in the palm of your hand with a ball point pen the word—CARD-BOARD.

Cardboarding is a hybrid system developed from several ideas related to bread-boarding.

The genesis of breadboarding is not clear. The term has earned a permanent place in the language of electronics.

Breadboarding is used to denote mock-up, dummy set-up, cut and try engineering, or any trial layout of a temporary nature. I have seen the term used in a paper on chemistry. A physicist told ne that he had seen the term used in nuclear physics. This is understandable because the first cyclotron was a converted wireless arc transmitter from Palo Alto, California.

Early application of the term, breadboarding, was literal. Wireless components were fastened to a bread, or cutting board, to insure some physical stability and order. This method provided good access for alterations and maintenance. The flat layout on a single plane provided the designer with a bird's-eye view. A breadboard made it possible to establish a link between the abstract mental process and the concrete physical work. Oftentimes a breadboarded circuit became a permanent fixture. Large telegraph repeater stations would use huge mahogany or cherrywood tables, complemented by lacquered brass fittings, to mount the components for hundreds of telegraph channels. Some of these handsome components are conversation pieces in homes today.

I suspect breadboarding evolved from the old manual telegraph practice of mounting components on the operator's table top. As the station prospered, the tables were needed for other purposes. The components were rearranged on boards and fastened to the wall.

Various illustrations, of Alexander Graham Bell's development work on the telephone, have that breadboard look. Mr. Bell was trying to develop a multi-channel voice frequency telegraph system, nearly a century ago, when he observed a bit of phenomanae that led directly to the development of the telephone.

Mr. Bell jotted down spontaneous ideas and observations on scraps of paper, on the backs of household bills or in a small notebook. A scribbled notation related to "undulating currents" is credited with winning the patent rights to the telephone. The notation was on the back of a household bill! This incident serves to emphasize the cardinal rule of cardboarding; Record the idea or observation now.

Breadboarding

The most ingenious, fastest breadboarding I have seen utilized 'glass-knob' thumbtacks. The components are equipped with pigtails before mounting on the breadboard. The wire pigtails terminate in small loops. Several pigtails are thumbtacked together

on the breadboard to form a solderless tie point. Some of these boards look awful hairy but they are simple and easily constructed. The glass-knob thumbtack method is still practical for low frequency projects.

Commercial breadboard kits

To maintain a smooth stream of consciousness during the creative phase, breadboard designs were improved to permit the physical work keep pace with the mind. This important factor has produced a variety of systems. Several commercial kits furnish patch cords, plug-in components and special boards. The boards may be wood, plastic or metal. The more economical and simpler kits use perforated phenolic panels and special clip or spring connectors for a solder-less tie point.

The makers of commercial boards emphasize saving time (speed), reusable components (economy), and structural visualization (spacial view). These systems do not integrate the schematic diagram to improve electrical visualization. Nor a means for recording, filing, indexing and duplicating the tests. The initial expense of the more elaborate kit is a disadvantage to economy minded experimenters. An elaborate kit, due to completeness, quality and flexibility is inherently costly. There are other features the experimeter may consider to be of greater importance. It is necessary to analyze the creative mind to illustrate that last statement.

The creative mind

All men are creative.

No race has a monopoly on invention.

All forms of mankind have contributed to the state of civilization that exists today. The ability to rationalize, to exercise logic and to project, are talents that distinguish mankind from animals. Another way of putting it; Man can prophesy. Current events seem to belie this, nevertheless, it is a fact. It is also true that mankind cannot predict every event in the future, however, the number of things mankind can predict exceeds the capacity to assimilate by any one man.

The creative talent varies among individuals. There are many factors that make up this talent. Some factors are inherited and others are the product of our environment. Most of these factors can be acquired

by self study and self discipline. Here is a list of the predominant ones; Motivation, Education, Opportunity, Reinforcement, and Serendipity.

Motivation: Motivation can be generated by the desire to serve and is the noblest of mankind's endeavors. The will to survive, which is inherent in all normal men. Curiosity will stimulate a man into doing all sorts of curious things. There are others not so noble but powerful such as prestige, power, money and greed.

Education: The sum of all your knowledge composed of experience, environment, academic or self-trained at least in the area of interest.

Opportunity: Opportunity is related and proportional to your education. The broadest education possible is the best insurance that you will be exposed to opportunities.

Curiosity: Curiosity is considered an inherent trait. This valuable trait can be developed and parallels education. Curiosity can lead you to bold origonal concepts.

Reinforcement: This factor is a concrete form of encouragement. A series of minor successes or rewards will sustain a man for many years on a single project. For the competitive man success, based soley on 'being a winner', will suffice to make him expend enormous amounts of energy.

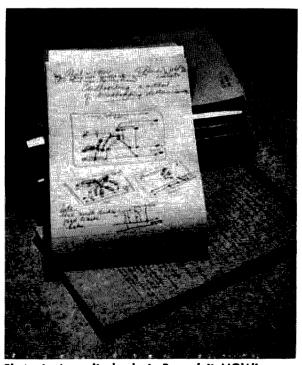


Photo I. A cardinal rule is Record it NOWI

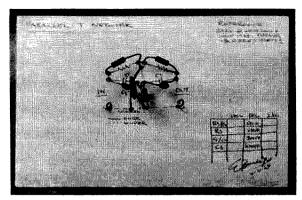


Photo 2. Groups of pinholes form tie points.

Screndipity: This is probably the least discussed but one of the most valuable traits a man can acquire. An artist would define serendipity in this manner; Use whatever means and materials you possess to create a thing of beauty. A prosaic man would simply state; Improvise.

Ideaphoria: This an obsecure word rarely found in dictionaries. Ideaphoria is the rate or volume of creative ideas. The word is used in aptitude test results. A high ideaphoria indicates a highly creative imagination in the individual. In the context of this paper I am using the phrase 'creative mind' to connote high ideaphoria. The creative mind is a fulcrum upon whose sharp edge is balanced a man's sanity. Should his other talents be properly distributed he will be a prolific producer. He will be using all his talents and enjoying peace of mind. If the individual has not inherited or developed the other talents, he will become a paralyzed egomaniac who could destroy himself through utter frustration.

The preceding paragraph parallels my experience which led to the development of cardboarding.

The creative mind does not conveniently have single ideas.

The creative mind is boiling with ideas. It must improve everything it observes. Ideas pop out like olive pits. Most of these ideas are lost in the confusion and stress of the moment. The secret of capitalizing on the creative mind lies in some means for capturing these transients. These means must provide a favorable gestation period where the ideas can be selected or rejected in a stable environment. The resultant effect is to immobilize your ideas so that they may be examined and re-examined when the

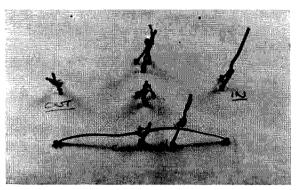


Photo 3. The pigtails are tacked together on the wiring side and lock the components to the card-board.

time and the attitude is right. The creative mind is capable of exploring many projects concurrently, with a little help. This discussion on the creative mind has led us, full circle, back to breadboarding.

In order to accent more desireable features that should be incorporated in the bread-boarding process, a lengthy digression on the creative mind was presented. At least one of these features should be obvious. Perhaps it will help if this rhetorical question is asked: Can you imagine how much money an experimenter would have to invest in a breadboard system that could handle a half dozen projects simultaneously?

The cardboarding system includes this feature, with considerable economy.

The great ones

Men who have contributed much to our technology and comfort were not men with one track minds. Study the biography of any one of these men; Franklin, Jefferson, Whitney, Tesla, Bell, Edison, deForest, Armstrong, Steinmetz and Lawrence. The names are usually identified with one great contribution. This great contribution was the pinnacle of their endeavors. It is a rare pinnacle with a broad base. All these men had creative minds, not one idea in one field but prolific in many fields. The key to their genius reveals itself, not in a formal textbook presentation, but in scribbled notes, crude sketches on scraps of paper and little dog-eared notebooks.

It is true, conception is rarely neat.

These great minds, the orderly scientist, the prolific inventor and the great innovators, how could they generate a shining image of order and enlightment when all that

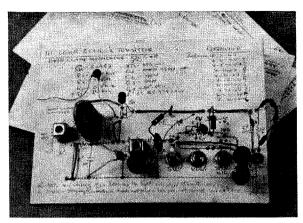


Photo 4. Jumpers interconnect the tie points either above or below.

can be found of the beginnings are scribbled notes and crude sketches? The answer to this question is the key to their genius.

Even though you scratch a word in the dust, it will be engraved forever in your memory.

Another way of putting it; It matters not the place nor time, nor why nor how. It does matter by rote or rhyme, record it now.

The cardboarding system

The cardboard feature of this system was one of many ideas recorded over a decade. The cardboard idea became the catalyst that bound several related ideas together to form an integrated system.

Cardboarding begins when you record the idea. (Photo I) The cardboard feature parallels the stream of consciousness during the development and testing phase. The system provides a record of progress and summaries. A method for filing the cardboard is provided. The information is crossindexed, retrievable and reproductable on the original cardboard. This list and illustrations explain each step applied in sequence.

1. Recording the idea:

The transient idea must be recorded immediately. This requires an ordinary pencil tablet (10c). The 5½x9 inch size with the least number of pages will insure that enough room is available on the back cover for indexing. Over a period of years the number of tablets you fill with ideas will amaze you. Use the most available to maintain some uniformity for storage. The front cover should carry the date of the first entry, when the last entry is made add it to the front cover. These two dates will give you random access to the correct notebook.

A clean page is devoted to the idea, no matter how incomplete the idea may be. A simple basic drawing and explanation is sufficient. The date, title or keyword and your signature is recorded at top of page. These items are then entered on the back cover, and is the beginning of the chronological index to provide random access to contents of the notebook. Subsequent entries are made chronologically on clean pages, the date and title is followed by word or words keyed to the change or modification. This is also transferred to the back cover.

When a cardboard is started: The original date, title from your notebook and signature is placed near the top edge. The starting date of the physical work on the cardboard is added on the date you actually begin. In some other area, either front or back, of the cardboard enter all previous and subsequent dates and keywords in chronological order. Include source or reference articles from books and magazines. As development progresses, continue recording on clean pages of notebook, index cover and the chronological list on the cardboard. This description appears to be complex. In practice it is simple because it follows a natural flow of activity and is a chronicle of that activity. If you adhere to this discipline, you will have a cross-indexed record that is nearly fool proof. Experience has revealed that time spent on records is small compared to the time spent on the whole project.

2. Cardboarding the idea:

- (a) Cardboard stock—ordinary file cards are too light for all but the simplest circuits. Posterboard will handle everything except the heaviest components such as large power transformers. Posterboard is supplied in 22"X28" stock by stationary and art supply stores.
- (b) Cutting stock—household scissors will cut the heaviest stock you will ever use. Illustrations show 5"X8" cards of various weights. Think small, 3"X5" think big, 8½"X11".
- (c) Schematic drawing—arrange components so the drawing will form groups of tie points and still maintain a readable schematic. (Photo 2) The tie points are a group of several pin-holes. They are spaced about \(^{3}\)/₁₆" apart. This allows the pigtails to pass through the cardboard separately to merge underneath or wiring side.

The ends are tacked together with solder. This method provides a locking feature for small self supporting components such as resistors, capacitors, transistors and diodes. A jumper wire on either side of cardboard can interconnect tie points. The schematic will be easier to read if components are properly spaced. Study photos 3 and 4. A simple bridged-T filter pad requires a minimum of interconnecting jumpers. The other extreme is illustrated by a cardboard of shielded inductors, switches, jack, potentiometer, crystal holder and transistor. Fortunately the components tend to stiffen the cardboard.

(d) Making the holes-Pinholes are made by a needle-chuck test prod. The larger holes, %" to %6", are made by burning, with a modified Ungar type burning kit. Woodburning kits are available in toy or hobby shops. The largest tip is stepped down to four sizes by a small lathe or bu chucking in an electric drill. (Photo 6.) The electric drill is clamped in a vise. The tip is filed down while the drill is running. Diameters between steps is not so important as maintaining a square shoulder between between steps. A flat face at each step will insure clean holes. Holes may be enlarged by wiping hot tip around inside of hole. (Photo 5). Extremely large holes are made by chassis punches. Burn holes can be cleaned with an old toothbrush. A small jar, with %" hole in lid, is an anvil. The cardboard is placed over hole of anvil for punching or burning. Anvil will catch any debris from burning and brushing. All the tools are stored in the filebox. Photo 7 of the file box shows all tools used in the cardboarding system.

(e) Recording changes: As development progresses record important modifications in the notebook with suitable index on back

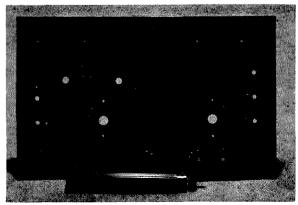


Photo 5. The large holes are burned in.

cover. The date and keyword is added to cardboard to maintain cross-index feature. When you reach a stage of development where you want to record progress, summarize in the notebook, and complete the cross-indexing routine again.

(f) Termination of development: When the project has been explored to a point where no further progress is anticipated, or development work is complete, the components are removed from cardboard and put back into stock. The final entry in the notebook should be summary with appropriate conclusions. The cross indexing procedure is applied to cover and cardboard again, before filing the cardboard.

3. Filing the cardboards:

File boxes are available in several colors. materials and sizes. Prices vary from 50c to several dollars. The file box shown in the photograph is 5"X8", of metal and finished light gray. It has a full length piano hinge and is of excellent quality. The retail price with indexed separators is less than two dollars. The boxes found in variety stores are of lesser quality and retail for less than a dollar. The larger boxes, 8½"X11". complete with separators and lock can be bought for less than two dollars. The use of an appropriate title for the project simplifies filing and access. If you can remember only one date of several that relate to the project, or the title of project, you can recover all the information on the project in a few moments.

4. Conclusion:

To insure successful operation of this system these rules must be practiced religiously;

(a) Get that spark of inspiration recorded, even though you write on the palm of your hand with a ball point pen!

(b) Paradoxically, the act of writing improves your memory.

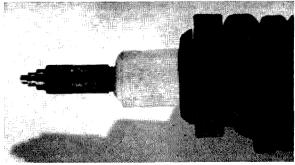


Photo 6. Maintain a flat face at each step on the modified tip.





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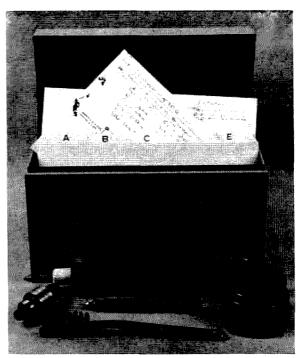


Photo 7. All the tools can be stored in the file case. The anvil was made from a discarded D-72 chemical developer jar. The hole in the top was made by the socket punch shown at the left.

- (c) Maintain the relationship between notebook, cover index and cardboard entries.
- (d) Use jumpers between tie points on the cardboard.
- (e) Plan the cardboard drawing to look like a schematic.
- (f) Before burning holes, brief your family because they may run around the house sniffing smoke.

(g) Continuous application of these rules will develop automatic reflex action.

Cardboarding should prove useful at all levels of research and development. Cardboarding could serve education in technical schools by using basic schematics, printed in quantity with prepunched holes, and distributed to the students. As part of the course every student should be required to maintain his own notebook, cardboards and file box. The system remains his property and becomes the foundation for building a solid background in electronics. This system will help the student to understand the working of the mind and develop professional discipline.

A youngster trying to master the basics of electronics through this system might be the man to put us on Mars or, eliminate us from the Solar system. Who knows?

. . . W6FTA

Buried Antennas for Emergency Communications

In this article, WIDCG describes some of the properties of buried antennas, particularly in relation to their usefulness for amateur Civil Defense or other emergency communications installations.

Many experiments have been conducted with sub-surface antennas in recent years to allow construction of bomb-proof communication sites and for communication with deeply submerged submarines.

Some scientists believe in the possibility of a super-conductive medium in the earth's crust so that antennas could be buried in the ground in an upsidedown fashion and communications established using this "earth ionosphere" much the same as surface antennas work in conjunction with the ionosphere.

However, experiments in this field have not been very successful and a buried antenna, for practical purposes, can be treated as having useful propagation only above the surface. The deeper the antenna is buried, the more inefficient it becomes because of the earth's absorption of the radiated energy.

What application do such antennas have for the amateur? Few amateurs are faced

with such a drastic situation that they can't put up some form of surface antenna, even if only attic antenna for short whip. However, for those engaged in Civil Defense or other emergency communications work, the installation of a buried, "back-up" antenna at a fixed station should be considered. It is quite a contradiction to see so many times an emergency communications setup in a relatively protected area—the basement of some public building, for instance—and then to see the antennas on which the usefulness of the installation entirely depends, dangling loosely in the open liable to any extreme surface condition, natural or man-made.

The purpose of this article is to review some of the types of buried antennas which might be useful for amateur emergency communications and to present some of the results the author obtained with a buried 40 meter antenna.

SURFACE INSULATED WIRE (A)

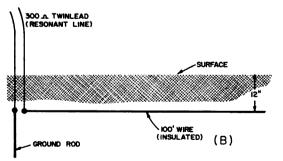


Fig. 1. The dipole (A) and 100 ft. long wire types of buried antennas. Constructional details are given in the text.

Buried antenna properties

Because a buried antenna is immersed in a very lossy medium and because of the sudden difference in medium which, a radiated wave encounters at the interface of earth and air, a number of factors are drastically different for buried antennas as compared to an antenna in air.

Because of the antenna being in a different medium, the length/impedance versus frequency characteristics are different. For instance, a simple dipole buried 1' in soil of moderate conductivity would be about 17½' long for 20 meters and have a center impedance of about 450 ohms. As may be imagined, these figures are very dependent upon the exact conductivity of the soil.

Because of the interface between earth and air, the radiation from a horizontal, buried antenna when it reaches the surface sets up a vertically-polarized ground wave. This factor, of course, is ideal for emergency com-

munications work with vertically-polarized mobile stations.

Antenna forms

Many different forms have been tried for buried antennas and even complex directive arrays have been constructed. However, for amateur purposes, the dipole and 100' long wire are probably the most useful forms. (Fig. 1.)

The formula for the length of a dipole depends upon ground conductivity as well as other factors and would not be of much use to the average amateur. The best procedure for constructing a dipole is simply to cut it to 80% of the free-space length and then trim the ends equally until the lowest SWR is achieved. If buried in an area where ground conditions remain stable, the length does not have to be changed again.

In areas where ground conditions and surface conditions (snow, extreme changes of vegetation) are not stable, the 100' long wire should be used. Although an antenna coupler, such as a transmatch, is required to allow compensating for impedance changes with varying ground conditions, the antenna can then also be used for multiband operation. In typical soil the input resistance of such an antenna will vary from 50 to 600 ohms and the reactance from ± j400 ohms over the 2-20 MHz range. The first resonance will be between 750 and 1800 kHz, which makes it effective from 80 meters on down. This type of antenna has been used by the Army in Viet Nam with good results over short tactical distances.

Construction

Whether a dipole or 100' long wire is used, the wire used for construction must be insulated along its length from the soil and care must be taken that moisture does not penetrate the tips of the wire or the connection to the feed line. Teflon insulated wire, numbers 22 to 26, is particularly suitable. Perhaps a less expensive method is to run plain rubber insulated wire inside plastic hosing. The ground connection for the 100' long wire can be a standard 4 or 5' TV type ground rod.

Efficiency

Many methods have been used for measuring the efficiency of buried antennas. Per-

haps the most realistic for amateur purposes is to compare the field strength from a buried antenna to a good, surface quarter-wave vertical. Experiments made on this basis have showed buried antennas of the dipole and 100' long-wire variety, when compared to a surface antenna resonant at the same frequency, to be about 40 db down for a burial depth of 1'. Roughly, this is about twice the order of magnitude reduction in signal strength as would take place between a 8' loaded 80 meter whip and a full-size quarter-wave 80 meter vertical.

Experimental results

The author constructed a 100' long-wire buried about 8" and operated on 40 meters. No impedance measurements were made but proper loading could be easily achieved with the use of a transmatch-type coupler, although some retuning was necessary periodically depending on whether the soil surface was moist or dry.

No surface, vertical 40 meter antenna was available to make signal comparisons but comparisons were made with a 40 meter dipole elevated about 40 feet. On local and short-skip contacts, the buried antenna was never better than 7 "S" units below the dipole with the average being around 8-9 "S" units.

Conclusion

Buried antennas still offer many possibilities for experimentation. The main caution to observe is that the length, impedance and other parameters of surface antennas cannot be used.

Buried antennas are terribly inefficient as compared to almost any type of surface antenna except perhaps extremely short, unloaded whips. But, for emergency communications installations, they do offer the possibility of having a standby antenna which is easily installed and which can be pre-tuned and immediately available for use should something happen to the installation's primary antenna.

W1DCG

Reference

For those who would like further detailed, engineering data on buried antennas, the following compilation of articles is extremely useful: IEEE Transactions, Vol. AP-11, May, 1963. Special Issue on Electromagnetic Waves in the Earth. IEEE, Box A, Lenox Hill, New York 21, New York.

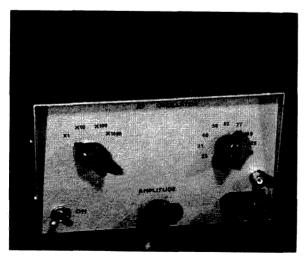
A Transistor Wien Bridge Oscillator

In this article, W6GXN discusses the evolution of a Wien Bridge audio oscillator that generates 25-200,000 Hz sine waves with very low distortion.

Virtually every audio oscillator, that the author has ever seen in laboratory use, is of a type called the Wien Bridge. This type of oscillator is characterized by a particular configuration of R-C tuning network. The original circuit of the Wien Bridge Oscillator is shown in Fig. 1, as it was first constructed using vacuum tubes.

In Fig. 1, the two stage circuit sustains oscillations because of the phase-shift of the bridge (at a particular frequency) and the phase shifts of the two amplifiers (assumed constant over the frequency range of interest). Such an RC oscillator would produce a highly nonlinear waveform (like that of another R-C oscillator, the astable multivibrator), if it were not for the nonlinear resistance "r". The resistance r is variously called a positive-temperature-coefficient thermistor, a barretter, or a light bulb.

When the circuit of Fig. 1 is in its desired state, the tubes are running in class A, and



Front view of W6GXN's Wien Bridge audio oscillator.

the output is sinusoidal. A change in operating state toward class C (which would produce a much larger output of highly distorted waveforms) causes more current to flow in the Ra-r side of the bridge. This increases the temperature of the light bulb (r), which causes its resistance to rise. The increase in resistance of r causes the gain of the amplifier stage V₁ to decrease, which restores our original operating level.

To see how the lamp resistance varies with current, Fig. 2 depicts a (commonly used) 6 watts 120 V lamp E-I plot, with several lines of constant resistance drawn in for reference. The translation of the tube-type Wien Bridge circuit into a transistorized version has had many problems, and the solution of these problems has been so complicated that the basic simplicity of the Wien Bridge oscillator often has been lost. In many a transistorized Wien Bridge audio oscillator, when the problem areas have been designed around, the resultant circuit hardly resembles the original Wien Bridge at all. This is not bad, per se, and several good Wien Bridge audio oscillator designs have come forth using bipolar transistors. 1,2

Basically, the reason that the Wien Bridge oscillators using bipolar transistors are so hard to build is that ordinary transistors have a relatively low input impedance in the common emitter configuration.

In Fig. 3, we see a hypothetical Wien Bridge oscillator using bipolar transistors. Since the input impedance from base to ground is fairly low (approximately hrexf), this low impedance shunts R₂ and upsets the requirement that R₁ = R₂. Also, since hrexr is amplitude sensitive, frequency will be dependent on amplitude. These two problems generally force the designer to:

1. Use low values of R₁ and R₂, together with large values of C₁ and C₂. This means that resistance tuning *must* be employed.

Use some other negative feedback method for controlling amplitude, rather than
the simple lamp-in-the-emitter method.
Negative temperature coefficient thermistors and forward-biased diodes are two of
the nonlinear elements used for this.

With the advent of field effect transistors, the design of simple solid-state Wien Bridge oscillators came within easy reach. The FET has an inherently high input impedance in the common source configuration. However, most of the designs that the author has seen using an FET as the input amplifier, have not used the same sort of lamp amplitude control as used in the older tube-type circuits.^{3,4,5}

The circuits below were redesigned from the old vacuum tube Wien Bridge circuits, for simplicity and ease of understanding. The first attempt, Fig. 4, used the same type light bulbs as do many of the tube type oscillators,

and also used capacitive tuning.

The circuit of Fig. 4 used one of the relatively new insulated gate FET's, the RCA 3N98. With a maximum design-capacitance in each section of the variable capacitor of 500 pF, at the minimum operating frequency, very high resistances (many megohms) were required for R₁ and R₂. At such a high impedance level, the circuit readily picked up 60-Hz ripple, and it was quite essential that it be enclosed in a shielded cabinent.

The bridge-sensing amplifier was the only FET in the circuit, since this was the only place where one was needed. A conventional bipolar voltage amplifier Q_2 and a complimentary emitter-follower completed the oscillator. The emitter-follower was used to provide a low output impedance. The circuit was powered by a separate +28 volt regulated and +28 volt regulated and +28 volt regulated and +28 volt regulated +28 volt regulated +28 volt regulated +28 volt regulated +28 volt +28

lated supply.

Since the main frame of the dual variable capacitor was the common terminal, which was connected to the gate of Q₁, one would expect a fairly large stray capacitance to ground in shunt with C₂. This had to be equalized by a trimmer (C₃) across C₁ if oscillation was to be maintained near minimum C settings of the dual variable. Also, of course, an insulated (ceramic) shaft coupling had to be used on the variable capacitor shaft and the capacitor frame had to be supported by ceramic or high-quality plastic insulators. C₄ and C₅, in parallel with C₁ and

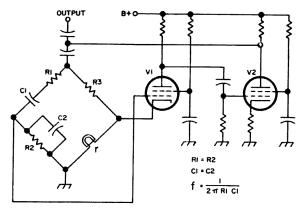


Fig. 1. Typical tube-type Wien Bridge audio oscillator.

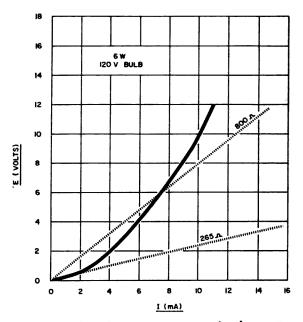


Fig. 2. E-1 plot of a 6 W, 120 V pilot lamp. Two constant resistance load lines are also shown for reference.

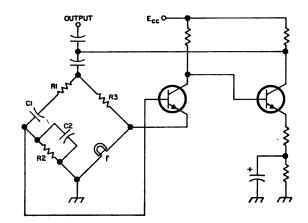


Fig. 3. Theoretical transistor version of the Wien Bridge shown in Fig. 1. Unfortunately, this simple adaptation isn't satisfactory because the low input impedance of the first transistor appears in parallel with R2 and loads it too much.

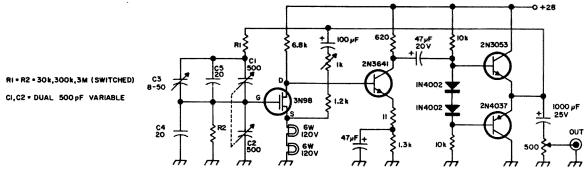


Fig. 4. First version of a moderately successful Wien Bridge oscillator. For low frequencies, RI and R2 have to be so large that the circuit is very susceptible to noise and hum.

C₂ were simply to fix the minimum tuning capacitance.

The design worked quite well in the ranges above 100 Hz, but the lowermost range (10 Hz to 100 Hz), where the required resistance values were 30 megohms, was unreliable, as feared. At this point, capacitive tuning was abandoned in favor of a combination of capacitor and resistor switching.

The second and more successful Wien Bridge audio oscillator was built using a junction FET. By switching both R and C, bridge component values are more manageable (and available). The C values in this second version are $0.52~\mu\text{F}$ to 500~pF, and the R values are between $100~\Omega$ and $3300~\Omega$. Fig. 5 shows the circuit of the oscillator; it is very similar to Fig. 4. The feedback control element used here is a Sylvania 120 MB lamp for which a typical E-I curve is shown in Fig. 6. Note that this lamp allows us to

use a single bulb to operate at a source resistance of about 600 Ω . Also, the Sylvania 120 MB is physically smaller than most 120 V bulbs and fits a small bayonet pilot lamp socket, like that for a #47 or NE51. The lamp is available from Allied Radio for \$0.46. The oscillator is constructed in a LMB-WIA cabinet, as shown in the photos.

The capacitors are switched only each decade, and the resistors are switched in ten increments between decades. The seemingly-nonsensical increments of frequency were chosen to give points that are approximately evenly-spaced on semilog graph paper—the type of paper usually used when plotting the frequency response of an audio amplifier. The four pairs of capacitors were "built-up" starting with 0.47 μ F, 0.047 μ F, 0.0047 μ F, and 470 pF capacitors, by adding small capacitors in parallel; a bridge was used. The resistors were all 1% tolerance types from

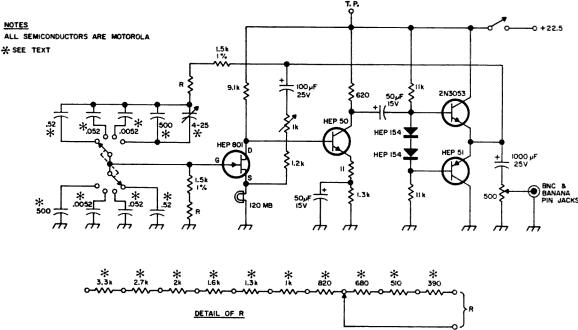
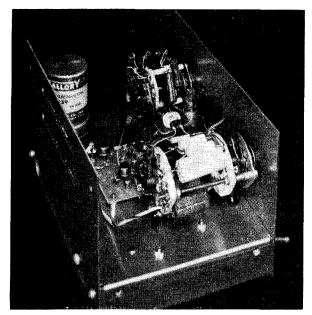


Fig. 5. The most satisfactory version of the Wien Bridge oscillator. This circuit is used in the oscillator shown in the photos.



Interior of W6GXN's audio oscillator.

a local surplus emporium; Their marked values were trusted.

As in the first oscillator, a small trimmer capacitor was placed in parallel with the C in the series arm of the bridge to make up for stray capacitance to ground (and the input capacitance of the FET.) This trimmer was not necessary except on the high range, where 500 pF capacitors were used.

A burgess U15, 22½ volt, battery was used to power the oscillator. It is mounted under the chassis in an Austin #113 battery clip. In this mounting configuration, the battery cannot damage the circuit board if it leaks. A test point is provided on the rear of the cabinet to test the battery voltage under load.

A quick check at 1000 Hz revealed that second harmonic content of the waveform was 48 dB below the fundamental. Higher harmonic content was greater than 50 dB down, with the even harmonics being the

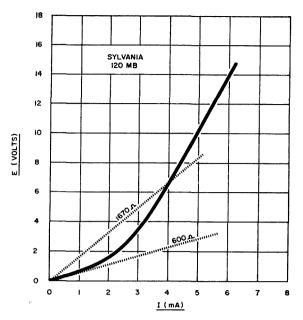


Fig. 6. E-1 plot of the Sylvanis 120-MB pilot lamp.

strongest. The output amplitude was within 1 dB across the entire frequency range.

The author wishes to thank Gene Howell, WB6JOV, for the photographs of the audio oscillator.

. . . W6GXN

Biblography

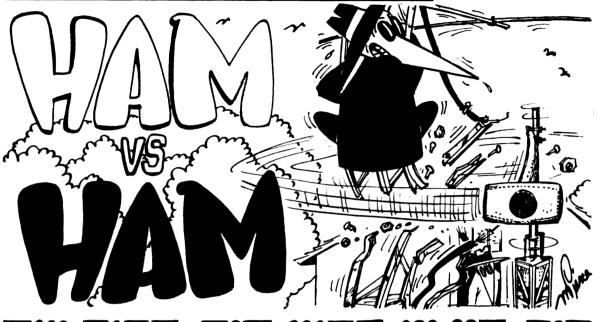
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- 2. Fulks, R. G. "A New 200VA Audio Generator" The General Radio Experimenter, Vol. 38, No. 1, Jan. 64.
- 3. Blaser, L. and MacDougall, S. "Applications of the Silicon Planar Field Effect Transistors". Fairchild Application Bulletin APP103 Dec. '64.
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- 5. Silinconix Incorporated, FET Circuit Ideas May 20, '66 p.3.

Proof Positive

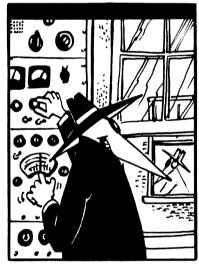
Have you ever found yourself with a fine project to build, and then discovered that you have all the components on hand but the rf chokes used in the circuit? Perhaps you've wondered if any of the chokes you have in your junk box will work. Well, here's a way to find out. It's an old idea, but a good one. The only equipment you need is a grid dip meter. Set the GDO to the frequency of the part of the circuit in which

you are going to use the choke. Then select a junk box choke that looks like it might work, and, holding one lead, touch the other to one of the exposed pins on the grid dipper coil. There will likely be a change in the GDO meter reading. The greater the change, the poorer the choke will work at the selected frequency. If little or no deflection is noted, the choke will work fine at this frequency. This is a good method for testing those TV peaking coils and other chokes found in so many junked TV sets.

SORRY-ABOUT-THAT, PROHIAS DEPT.

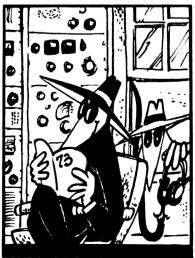










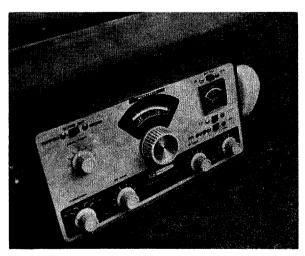




Have You Tried Air Mobile?

By some strange coincidence, the number of licensed hams roughly equals the number of licensed private and civil pilots. A guess would also suggest that the number of active stations would also approximate the number of active civilian aircraft (100,000). It also holds that there are a number of hams who are actively interested in flying. What the percentage is, I don't know. At a recent luncheon of fifty hams at the Colt's Neck Inn, six where active pilots, and at least two make it a regular practice to operate air mobiles. There must be a lot of interest, for whenever I operate from my plane, stations are always asking for detailed information on the equipment used, particularly the antenna.

I have tried many different arrangements, in different planes, with varying results. These range from meters in a luscombe in 1939 to a crystal controlled H W -12 in a Stinson from Isla Mujeres to Kew West in 1966. The results have been both good and bad. When I operated five meters in the Luscombe I used a superregenerative receiver. Since the flight (only one) was in the metropolitan New York area, everything could



Crystal-controlled HW-12 under the rear seat of the Stinson Voyager. Photo by W3PYF.

be heard (including ten meter harmonics), but with the poor selectivity of the super regenerative receiver, nothing could be copied.

In the 1950's many of us took part or heard of the work of Arthur Collins, General Butch Griswald, General Curt Lemay and others when they so effectively demonstrated to the Air Force the benefits of SSB for HF air-to-air and air-to-ground communications. For the past six years all my airborn hamming has been on SSB. Different planes and different equipment have been used but always with the same satisfying results. With the adoption of SSB and the availability of light, efficient transceivers, the utility and effectiveness of airborne ham communication has been greatly enhanced.

Our first use of a modern transceiver in a plane was with a KWM-2 in a Bellanca Cruismaster in 1960. In this case the KWM-2 was set on the rear seat, the power supply on the floor and all connections were made to a terminal plate about 3" x 12" on the lower right panel of the rear of the seat. Use of this panel avoided alternation of the plane's weight and balance. The plate had outlets for 12 V DC, Audio, and antenna. The antenna and audio used phono jacks and the 12 V DC used standard 110 V polarized female outlet. Naturally it was fused. For an antenna, there was the fixedsense antenna for the ADF which ran from the top of the cabin to the tail. It was just short of a quarter wave for 20 meters.

A switch was added over the pilot's head, which changed this antenna from the ADF to the outlet plate in the rear through a loading coil and coax. This loading coil made the antenna resonant on twenty. There were other positions on the switch which provided for operation on 40 and 75 but very little were done on these frequencies as the performance there left much to be desired. I have never had much luck from the plane

on frequencies where the antenna was not nearly resonant in itself, or where it needed a large loading coil. This arrangement was used with great success on many trips to Florida and one from Florida down through the Bahamas to Haiti, the Virgin Islands, Puerto Rico and back to West Palm Beach in February, 1962. All of the trip was on twenty meters. There was constant communication from our take-off at Stuart, Florida, heading out over the water to Great Exuma, with one stop at Grand Bahama. Communications were solid. There was a brief time after the ground wave gave up and before the sky wave came in when contacts were made with stations in the north. but at no time were we out of contact on the ham radio. In fact, when we were in sight of West End, Grand Bahama, and could not raise Palm Beach on the aircraft VHF radio, Bud Walker, W2EE/4, parked in his car in front of the Palm Beach Tower. stepped in and closed our flight plan for us after getting our request for the same on twenty meters.

This was my first experience at overwater flying in a single engine plane. As they say, the engine always goes into automatic rough when over water, and this was no exception. What a wonderful relief it was to have W4RNT and many others ready to summon help immediately if it was needed. It wasn't until after our return that I learned that Babe, W4RNT, my anchor post, could not find Georgetown, Great Exuma, on his maps spread on the floor of his shack as he followed our course. After an overnight stop at Georgetown, we left early for Port-Au-Prince, Haiti. The whole crowd was waiting for our appearance on twenty meters which kept us company constantly.

At Port-Au-Prince we were met by HH9DL who escorted us to his plantation on the north coast, near Cap Haitien. Don, HH9DL, whom we had met on twenty meters, also is a pilot. After talking to him several times on twenty meters we accidently met while we were both grounded in Salisbury, Maryland, on account of weather. He has been flying his Cessa 195 back and forth between Miami and Haiti for eight or ten years. It was his encouragement that inspired me to make this particular island hopping flight.

Don helped us clear customs, which spoke only French, then led us, in his 195 back north to the plantation, about a hundred



Alan W3ZP and his wife as they prepared for a flight to the Virgin Islands. Photo by W4RNT.

miles. It took only 45 minutes by air but would have been an all day ride over impossible roads.

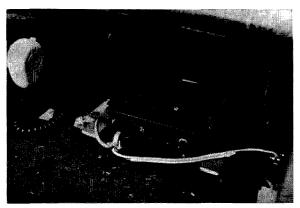
A few beautiful days were enjoyed at the plantation, where the hospitality included their Mar'd Grau. HH9GR, George Rippey, and HH9DS, Dick Smith, are also with the plantation Dauphine.

Returning to Port-Au-Prince for one night and some shopping, there was an early takeoff and over the mountains skirting the Dominican coast some 30 miles over Mona Island, Puerto Rico and landing at St. Croix, Virgin Islands. non-stop.

At no time was there any breakdown in the ham communications with any stations following our course constantly. Very comforting as, for the most part, it was our only communications.

The return trip went about the same way. To San Juan, then over water with no sight of land for some 500 miles to Great Inagua. A gas stop there and then non-stop to West Palm Beach. The ham contacts were continuous. Between Great Exuma and Nassau, we talked to, passed, but never saw, W1PRI, who was flying his Bonanza south and operating his KWM-2 on twenty meters too.

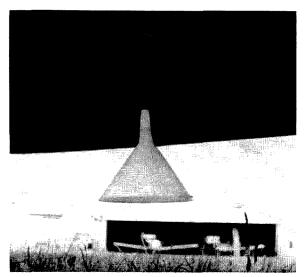
Frank Melville, W2AQK, followed us that



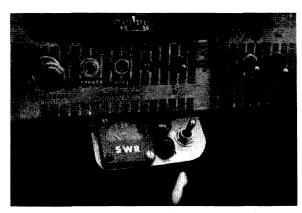
The HW-12 DC supply installed under the rear seat of the Stinson Voyager. Photo by W3PYF.

day by about an hour, but we did not see him after leaving San Juan. He had no air mobile, just a KWM-1 which he carried in his baggage. He had set it up on St. Croix. With no air mobile, he was sort of out of the club.

After that trip, and at W1PRI's suggestion, we obtained a surplus WW2 electric antenna reel, which are so plentiful. They are designed for 24V DC, but they work quite well on 12 V. They are used with a reflected power meter. Just run the antenna out till there is minimum reflected power. This is done for any frequency and provides excellent performance; - far better than the shorter antennas. Of course remember to reel in the antenna before landing or carry along a lot of spare antenna wire. We have used 40-lb. test phosphor bronze fish line successfully at 100 mph speeds, but heavier wire, with a cotton center, is necessary for the 150-200 mph speeds. A two to



Antenna and funnel hanging from the belly of the Stinson Voyager. Photo by W3PYF.



Electric antenna reel control and reflected power meter. Photo by W3PYF.

four inch plastic funnel on the end of the wire serves as an effective drag.

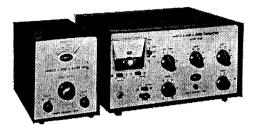
If you do make any trips with an air mobile, you will probably find that you will want some ham radio at your destination or stops. Take along an ac supply and some wire for an antenna.

Later the KWM2 was replaced with an HW-12 crystal controlled on 3999 per April 1965 QST. With the superior performance of the long antenna, distances up to 800-1200 miles can be covered consistently without the dead spots of the higher frequencies. Later this whole set-up was taken from the Bellanca and installed in a 1948 Stinson. As shown in the photos, here again everything is plug-in. Not only does it simplify conformance with the FAA regulations but it is also possible to take the HW-12 and power supply from the plane to the car in a few minutes.

In the winter of 1966 a fine trip was enjoyed in this Stinston. Starting from near home at Doylestown, Pennsylvania, one bitter cold morning, the night was spent at Memphis after stops at Cleveland, and Bowling Green, Kentucky. The next night it was Rockport, Texas. Then on around the Gulf with stops at Tampico, Vera Cruz, Ciudad Del Carmen and across the Yucatan jungle to the isle of Women, Isla Mujeres.

If you examine the radiation pattern of a horizontal antenna as given in a handbook, you will see that there is a lot of very low angle radiation from a horizontal antenna many wavelengths high. This is born out in practice from the plane. Signals on the long skip are very good. There was no problem working clear across the gulf on 3999 even during the middle of the day. The distance was as much as 1000 and 1200

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miles. I have also noticed times when I could hear and work these long distances while they could not be heard at fixed stations directly below me.

An Ac supply was carried on this Mexican trip along with a portable antenna. It came very handy on the Isle of Women. The operation there was not legal, as we had not gotten a Mexican license and there were no hams on Isla Mujeras whose calls we could borrow. Of course we were not legal flying over Mexico either. We always signed our location as south of Brownsville.

We were held up at Isla Muieras by bad weather for several days. There was no way of getting weather reports or forecasts. We particularly needed to know the windsaloft forecast for Key West in order to calculate our ability to reach Key West, 400 miles away, with the fuel we had aborad. One morning, before the weather had cleared, we had a brief contact with Art Lynch, W4DJK, in Fort Myers, Florida. All of those contacts from Isla Mujeres were brief. Our hotel room was less than 100 yards from the government radio station. Their key clicks were loud and I did not want any questions asked about the legality of

my operation. Art called the airport in Fort Myers and got a favorable wind and weather forecast. Even though the weather looked bad where we were, with rain and low clouds, we took off keeping low and under the clouds in rain. The weather did improve after we were about 200 miles out. It is a good thing we had that report from Florida for had we not made it that one day, the weather was bad for the next two weeks. Also, it is extremely hazardous to fly into unknown weather when you are forced to stretch your fuel supply.

During this flight was the only time we lost ham communications. Nothing could be heard on the receiver. Later I found it was just a short in the speaker plug, but it did put us out of business. The boys in Florida did hear my transmissions, I learned later. On landing at Key West, I phoned Arthur immediately and relieved the concern of the many stations listening.

As with automobile mobile, air mobile is more useful on a long trip than on a short trip. I feel that it is a must for trips outside the country where public communications may be spotty. It has certainly proven itself to be very useful. . . . W3ZP

FM Subcarrier Generator for Ham TV

Amateur television, or ATV, is beginning to become quite popular. The availability of inexpensive vidicon cameras and the many articles appearing in ham magazines about TV have made it possible for the ham who wants something different, but not too difficult or expensive, to try ATV. However, one big problem of ATV'ers has been transmitting audio. One method is to use a completely separate transmitter and receiver system, as for example on two meters. This requires a lot of extra equipment and cost, and means that your audio cannot be received on a standard TV set used for video reception with a converter.

Another method of transmitting audio is to use a completely separate transmitter 4.5 MHz away from the video carrier and either feed the audio signal to another antenna or through a complex diplexer to the common 440 MHz TV antenna. This method is also expensive as it requires a complete transmitter and power supply for audio.

A better approach, I feel, is the simple

4.5 MHz FM subscriber generator described in this article. It produces more than 1 V P-P carrier which can be fed into your video modulator either at the camera end of the cable, or at the modulator. The components are not critical; the transistors can be almost any of the inexpensive new epoxy-cased types.

The circuit (shown in Fig. 1) consists of two stages of audio amplification from a high-Z microphone feeding a Varicap-controlled oscillator at about 4.5 MHz. The Varicap changes capacitance at an audio rate giving true FM output. The fourth transistor is used for isolation and to provide a low impedance output.

The generator can be built in many different ways: Vector board, Veroboard, etched circuit board, etc. A convenient method is to use plain insulating board with holes drilled for components and jumper wires for connectors. Care should be taken to prevent ground loops or pick up from long leads if used on the same chassis with a transmitter

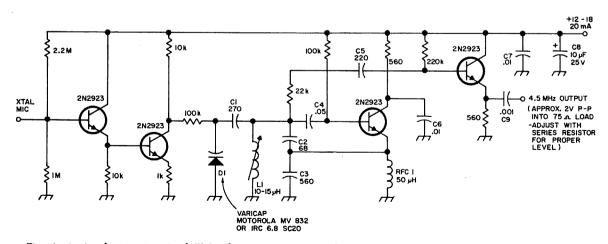


Fig. I. A simple transistorized FM subcarrier generator for transmitting audio on a video transmitter.

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and modulator. The best way to wire the circuit is in the same order as the schematic.

The generator is easy to test. Apply power, and if nothing smokes, listen for a signal on a general coverage receiver tuned to 4.5 MHz. Adjust the slug of L1 if necessary. Then connect a crystal or high impedance dynamic mike and check for FM audio output by listening to the receiver. If you don't have a receiver that covers 4.5 MHz, you can connect the generator to your video monitor if it has an audio as well as video input, or connect the generator to your modulator and transmit on the air.

Unless you have a scope with response out to 5 MHz, it is hard to tell how much audio subcarrier voltage to out with the video. The usual ratio is 1 V video to ¼ V P-P audio at the modulator input. This is assuming that your modulator is flat out to 5 MHz. If it is not, then you can peak it up at 4.5 MHz by adding a tuned circuit as shown in Fig. 2. This added circuit may give you greater definition, too.

Now as for the transmitter, tune the final to favor the upper sideband since your receiver is tuned that way. The only drawback with this system is that the audio is going out on the video carrier, and subtracts a little power from it. It's only a small amount, and shouldn't make much difference.

This method has been used successfully in the Los Angeles area. It enables simultaneous conversation between hte transmitting and receiving stations for quicker and better fine adjustments.

For any reader who doesn't feel like making his own generator, I can supply the finished unit on a printed circuit board for \$15 postpaid.

.. W60RG

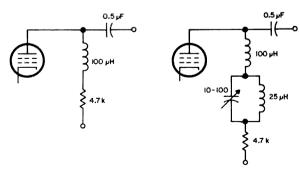


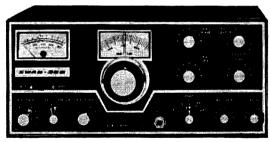
Fig. 2. Improving your video amplifier-modulator's response at 4.5 MHz. A typical circuit without a 4.5 MHz peaking circuit is shown at left, with the added components at right.

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A Low-Cost Vertical Antenna

A number of manufacturers make simple vertical antennas with loading coils. These antennas take little space, work on all bands, and perform well. Here's a home-made version of this type of vertical antenna that can be made very easily. The drawing tells how to make it. Adjustment is very easy. For eighty meters, set the shorting tap about one-third of the way down the coil. The feed line should be set a few turns up from ground for a starter. Then try different settings until the SWR is as low as you need to get it. I get about 1.1:1 at 3.68 MHz. So far I have worked stations in Alabama and out to the East Coast during the evening hours, and stations in the surrounding states during the day on 80 meters. My signal reports were no lower than S-7 using about 160 watts input. Total cost was under \$5. . . . John Sharples WA9MYR

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James Dandy Diode Tester

Jim Asha W2DXH Freeville, N. Y.

If you've wondered how to check the condition and characteristics of junk box diodes, here's an article for you. It's a simple, inexpensive tester for low voltage diodes.

I think that semiconductor diodes are almost as useful in circuit construction as resistors and capacitors. Used properly, diodes are good for all sorts of tricks beyond detecting rf and rectifying ac. Well, I recently saw a chance to acquire a huge batch of assorted computer types at an irresistible price (five dollars), and my resistance being what it is, I bought them all. But when I got them into my lab, a new perspective emerged: which ones are good? As I was sorting out the color coded varieties, I developed an idea.

Like Topsy, the idea growed up! It became a schematic and some simple calculations. It developed into a mess of clip leads and components attached to a Heathkit oscilloscope. And finally I built . . . a James Dandy Diode Tester.

This simple circuit tells which end of the diode is which, what its reverse breakdown characteristics are, and it gives you a rough indication of quality. You'll have to try something else if you're interested in determining rf performance or pulse risetime and turnoff characteristics, but you can tell if it's worth further attention. The Tester also checks zeners and transistors by observing the properties of their inherent diodes. And maybe

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6.3 VAC

DIODE CASE

Fig. 1. Basic circuit of the Tester.

there are one or two other uses we can find for it.

Theory

If we pare all the trimmings off the James Dandy Tester schematic, we end up with Fig. 1. This shows a high-voltage transformer in series with a resistor and a diode, and an output terminal added across the diode. Note that the diode points up. A second winding which provides the scope sweep voltage is not needed for a basic explanation. So let's work out what happens when the circuit is turned on. The key lies in the diode properties of reverse breakdown, forward conduction, and internal resistance.

The dotted box in Fig. 1 represents the shell of the real diode. Electronically we can never open up this shell and find something inside that visibly accounts for what the diode does. But we can suppose there's a perfect diode inside the shell, and a resistor that somewhat spoils the diode's properties. Then we can describe the real diode's behavior in terms of this model. My diode-

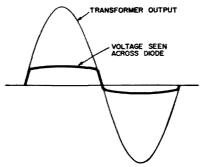


Fig. 2. Where the diode characteristics curve comes from.

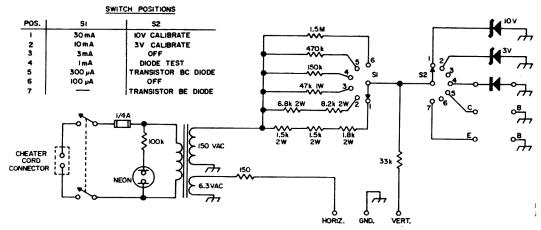


Fig. 3. Complete schematic of the James Dandy Diode Tester.

resistor model is very simple but it'll get by for now. So let's say the perfect diode goes into reverse breakdown at 20 volts, forward conduction at 0.7 volts (appropriate for sliresistor has the rather high value of 100 con, choose 0.2 volts for germanium) and the ohms.

Fig. 2 illustrates the resulting situation with two superimposed curves. The upper curve represents the 150 volt RMS sine wave, always seen at the transformer terminals. The lower curve shows what we see at the diode terminals, generally a much lower voltage. Let's follow this through a complete cycle.

Starting at zero volts and going in the positive direction, we follow the sine wave along its natural course until it reaches 20 volts. At this level the diode goes into conduction, and the circuit sees the 100-ohm resistor as a heavy load with its bottom end held at 20 volts. This state continues until the transformer's sine wave returns to the 20 volt level on its downward swing. Then the diode goes off, we return to the sine curve, and follow its natural course back to zero.

The 150 volt RMS wave goes to 212 volts peak at the center of the half-cycle. We see roughly 200 volts across 10 Kilohms, or about 20 mA at this instant. Passing through the diode's 100 ohms, this current adds 2 volts to the perfect diode's 20 volts. We will have to push the top of the diode voltage curve up a little bit, and we should round off the corners since that's what we expect to find in a real circuit. This is how we get Fig. 2, which very closely resembles the real curves you will observe using a triggered or sawtooth sweep.

The negative half-cycle closely resembles the positive curve, but the break points are very much closer to zero. The (silicon) diode takes over at 0.7 volts rather than 20 volts, and the curve bulges in the opposite direction because the current flow is reversed.

My transformer has a 6-volt heater winding which I put to use as a horizontal sweep source. This gives a linear presentation. That is, starting at the center of the trace, which should rise towards the right, percentage of distance to the end equals percentage of peak applied voltage. This eliminates using a simple trig equation if you want to know the diode current at any part of the curve. And it gives a presentation closely resembling the manual and textbook illustrations. By changing some output connections you can get an exact correspondence.

Depending upon conditions of operation, 200 volts or more can appear at the Tester output terminals. If you're looking at fine detail in the diode characteristics, this could be applied directly to your scope's input tube. The 33k resistor in series with the vertical output terminal limits current flow under these and short-circuits conditions to

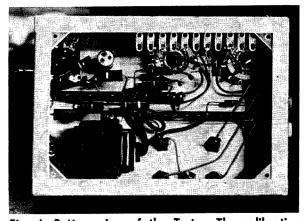


Fig. 4. Bottom view of the Tester. The calibration zeners are on the lug strip at the upper right hand corner of the chassis.

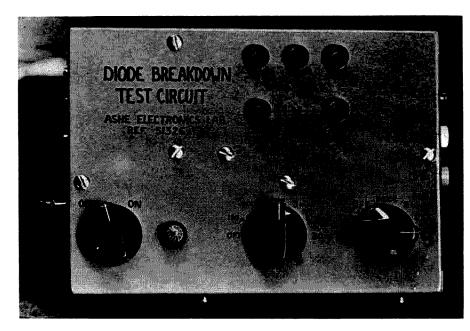


Fig. 5. Top view. I finished the Tester with slow-drying enamel and freehand India ink lettering.

5 mA or so at the price of a slight loss in signal amplitude. A much larger current is available at the diode test terminals, so watch your fingers! Turn the Tester off when changing diodes.

Construction

Fig. 3 shows a complete schematic of the Tester. Those protective resistors and the two-pole power switch might seem a little elaborate to you. But I've been in this field for some time and I think I've blown as big fuses as anybody, and got bit a few times too. The lots of little precautions like these tucked away in everything I build add up to a pretty fair insurance policy for me as well as the gear.

A 5x7x2 chassis serves as case and panel,

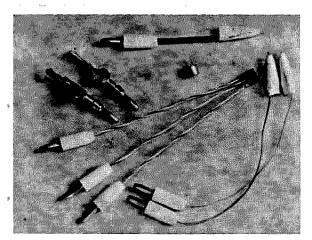


Fig. 6. Assorted leads for the tester. They go well with the Heathkit transistor tester too.

and a bottom plate makes a worthwhile improvement. All wiring is point-to-point, and three 11-lug solder strips provide additional useful tie points. About half the lugs actually got used. Fig. 4 shows a bottom view of the Tester.

You can see the transformer in the lower left hand corner of the chassis. If your transformer won't go in upside down there is lots of room on the back wall. The AC cheater-cord connector goes in the LH side wall beside the transformer, with a half-inch of clearance around its solder lugs. The fuse-holder is in the same wall perhaps two inches forward. There wasn't enough room for it on the top, and fuseholders aren't very interesting anyway. I might have used a TV solder-in fuse and saved cutting a hole.

On the top surface, three rotary switches and a neon pilot lamp are mounted on the same line slightly more than one inch from the front wall. See Fig. 5. With the transistor and diode terminals toward the rear, there is a clear area across the inside of the chassis which takes two of the three 11-lug strips.

I used banana jacks for all test and output connections. They seem to be more convenient than anything else. Fig. 6 shows a collection of connecting adapters made up for the Tester. The ones on the left are made up of Grayhill #2-0 breadboarding terminals soldered onto banana plugs, and they are particularly handy when testing diodes. The others are make up of banana plugs and some light and some heavy wire, with Mueller's micro-gator clips. The more common alligator

clips just don't get a grip on fine wires and transistors leads. Somewhere in there is a transistor socket with short leads, which I might have color-coded emitter yellow, base green, and collector blue. These assorted adapter leads tend to congregate on my Heathkit transistor tester when I'm not checking diodes.

A rotary switch turns the power on and off. I always use a rotary switch in this critical location. A toggle switch could collapse someday, accidentally turning on the circuit. A rotary switch can't possibly do that,

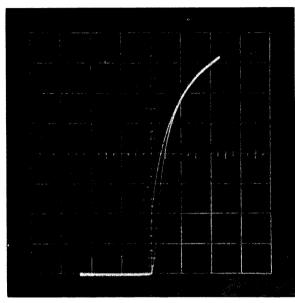


Fig. 7A. Germanium diode characteristics, showing gradual breakdown with increasing reverse voltage, and low forward resistance.

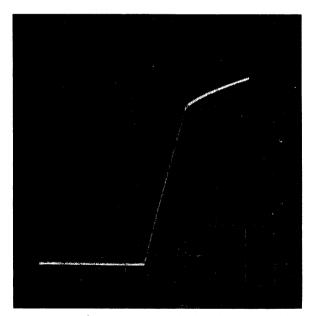


Fig. 7B. Another germanium diode, showing a sharp knee but poor dynamic resistance.

and its general health is immediately apparent just by looking at it. I like that.

The other two switches are single-pole non-shorting (make after break) rotary switches, and any of several varieties are usable. Mine were assembled from CTS parts, purchased in little boxes and then you assemble what you need. I see some nice switches in Allied's #260B catalog on page 308. They are Mallory's Series 3200J non-shorting single-gang switches, and they come already assembled.

When you are finishing up the circuit, leave the transformer heater leads a little loose. You may want to reverse them. Before you finalize things, hook up the tester to a scope, set the scope to very low vertical sensitivity, and see which way the trace goes. It should be a straight line, rising to the right. That is, if a positive voltage to the scope's vertical input deflects the spot upwards, and to the horizontal input deflects the spot to the right. Otherwise you may have to redraw the curves shown in the illustrations.

The calibrating diodes go in last. Finish up everything else, and use the Tester to choose them. They'll be zeners or other diodes that show good zener characteristics. Details follow shortly.

Component values in this circuit are not critical because I don't expect too much from it. If I need exact measurements I get them somewhere else. I've chosen properly sized resistors so you can leave it on all night without anything roasting. If you want to change those resistors, it's easy. Ohm's Law:

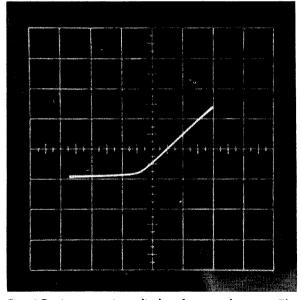


Fig. 7C. A germanium diode after overheating. The scope gain is very high, so we see that its diode characteristics are nearly gone.

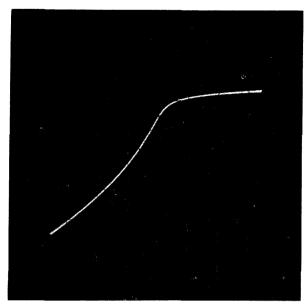


Fig. 8A. BE diode of a germanium transistor. Downward curve indicates a PNP transistor, and rather vague conduction and reverse characteristics suggest high leakage.

RMS voltage over resistance equals RMS current, and you can see in Fig. 5 which values I chose. If you can't find a 150 volt transformer, compute new resistances for what you have available. I wouldn't use a lower voltage because some transistors and small diodes show breakdown voltages in the 100-volt range.

The case is finished off with good enamel and careful hand lettering. I won't go into detail on that because it's pretty well covered by my article on the subject in the March 1967 73.

The calibrating zeners

If you have a scope with fixed voltage ranges, you probably aren't interested in the calibrating zeners. If not, you need them, but how are you going to find out what their values are?

Perhaps you have some zeners of known characteristics, but the usual 10%, 20% or greater tolerances seem rather excessive. If you're familiar with your VTVM, you may have guessed the answer already: use its ability to indicate peak-to-peak AC voltages.

A review of the meter manual should answer any questions that may arise. So far as I know, all inexpensive VTVM's use a peak-reading circuit, with a meter scale that is labeled for sine-wave readings. We'll just convert those estimated sine-wave figures right back to P-P, by multiplying by 2.82. Or perhaps, like my Paco, P-P scales are

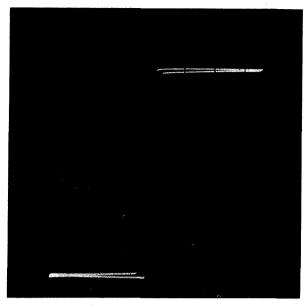


Fig. 8B. BC characteristics of the same transistor. This curve is also downward, and it shows a very sharp conduction and breakdown knee.

included on the meter face.

Set up the Tester and your oscilloscope. Attach your meter ground lead to the Tester ground return, and the meter probe to the scope Vertical Input terminal. Set the VTVM for AC measurements and start testing diodes. When you come to a diode that has nice sharp corners and flat top and bottom, make an RMS reading, convert to P-P, and you have that diode calibrated. I think 3 volts is a little low, because I went through nearly a hundred diodes and transistors before I found one of this value; you might try 5 volts and you'll find one quickly. Three more of them would add up to 15 volts, and these are probably better choices than 3 and 10 volts.

Remember to make your measurements at the same current you will use when calibrating the scope. My zeners give true readings at 1 mA; you'll get sharp corners more easily at a higher current.

Testing diodes

The quickest way to understand the Tester indications is to put a diode in it and then work out the meaning of the different parts of the curve. Repeat with several different diodes. Most everything you need to know is in the theory section, and in several widely distributed handbooks. Just take a little bit at a time and ask, how did it get that way? I've included some illustrative photos and

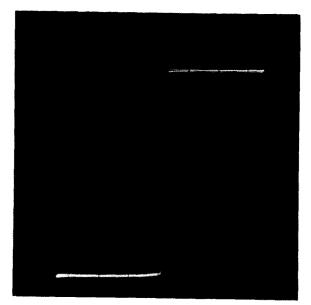


Fig. 9A. It's not obvious here, but this silicon transistor BE diode curve turns upwards.

brief explanations.

All bipolar transistors have two inherent diodes. One is the base-emitter diode, and the other is the base-collector diode. The Tester checks these diodes one at a time, and it doesn't tell you anything about how the transistor will work. But if one of the diodes is bad, the transistor won't work. And the direction the curve goes indicates whether you have a PNP or an NPN transistor. See Figs. 8 and 9.

Why do many diodes show a double line in the vertical parts of the pattern? These lines merge at higher currents but are very distinctly separate for small currents and large diodes. I think this is phase shift of the applied voltage through the RC network of series resistor and reverse-biased diode capacitance before it goes into breakdown. In that case, the LH line would be the right-ward-going trace (phase retarded).

Zener regulators

Do you have trouble finding zener regulators? The Tester will find lots of them, and tell you how they'll work in your circuits. It's so handy for checking zeners it belongs in my zeners article (73, October 1966) but when I wrote that I hadn't thought of it yet.

It turns out that not only specially built silicon diodes will serves as zener regulators, but some unspecial diodes and even germanium transistors! The Tester finds the ones that can regulate, and some of you out there

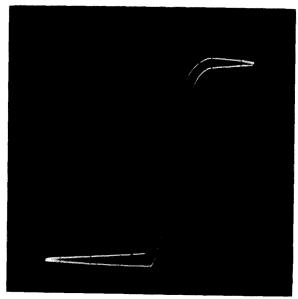


Fig. 9B. BC characteristics of the same transistor. I don't know what causes the very noticeable phase shift. Can somebody tell me?

working with low-power circuits can now find very low-power zeners to go with them. Wish I'd found out about this sooner! I haven't done any work in the matter, but I expect germanium zeners aren't going to show as good temperature stability as silicon zeners. Well, that is another problem. Fig. 11 shows the base-emitter breakdown characteristics of an unlabeled germanium computer transistor from somebody's printed circuit board.

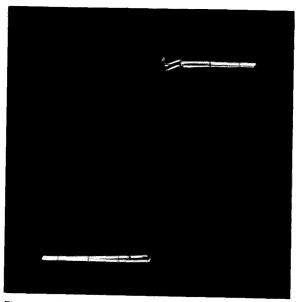


Fig. 10. A very close look at a perfectly good GE Z4XL6.2 zener diode. It shows some zener noise under 200 microamps, and low dynamic resistance.



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Closing comments

The Tester can supply lots more power than is required to roast a good diode into complete uselessness. Fortunately, this is harder to do than you might think. The power dissipated in the device is the usual product of voltage times current, and since most transistors and diodes break down at under 20 volts, and can take over 100 milliwatts ,the average danger line lies around 5 mA. But some transistor may unexpectedly show a base-collector breakdown at 50 volts or more, and if it's rated at 60 mW you may easily overdo things. I hope you'll try to roast a few semiconductors to get a feel for what you can and cannot get away with . . . just watch the scope and you'll see the curve begin to slump off towards a straight line. Then heave the poor thing into a nearby wastebasket so it can't end up in one of your circuits.

If you're careful to use things only for their intended purposes, you are missing a lot of fun. What can you do with the Tester? Try a little neon lamp at low current. Another thought that comes right to mind is that perhaps it can be used in some way to check computer switching cores. I'm sure you can work up some new ideas. And as you puzzle them out you'll pick up a few pointers enabling you to make better use of this simple but surprisingly handy James Dandy Tester.

. . . W2DXH

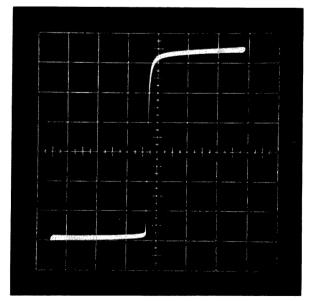


Fig. 11. BC reverse breakdown curve of an unknown computer-board germanium transistor. This one would make a good low-power zener.

Some Commandments for DXing

Considering that the avalanche of DX activity has continued unabated through the worst of the past sunspot cycle, it seems logical to presume that the future months of increased sunspot activity will bring more and more "country-chasers" to the 80-10 meter bands. Therefore, in order to prescribe some measure of order in the impending chaos, it was decided to formulate a Ten Commandments of DXing. What finally emerged does not quite qualify for this dignified title, although there are ten rather broad rules, so it is offered to you simply as some commandments for DXing.

- 1. Keep Up To Date: When Gus, Don, Jose, or whoever is making the current DXpedition circuit, are on the road you've got to know about it, because if you miss the places they go it may be a long, long time before you get another chance. There are several good DX publications which furnish the latest possible information on who is going where, when, and what frequencies and modes to listen. Among the leading ones are Gus Browing's DXers Magazine (W4BPD), the West Gulf DX Bulletin (W5IGJ), Geoff Watts DX News-Sheet from England, and DX-Press (PAØLOU) from the Netherlands.
- 2. Never Make More Than One QSO per Band per Mode—with a DXpedition, or better yet on the very rare ones keep it to one QSO PERIOD. DXpeditions are usually staffed by good operators. If you work him you'll be in the log so there is no need to deprive others of a chance by making repeat contacts.
- 3. Listen to Instructions: If Don says, "Tuning up 5," then for crying out loud stay off his frequency, and if he says call again, "Only the station ending in item, foxtrot," then chances are it's my turn so

- give me a chance. If he says, "QRZ W7's only", then give the 7's a chance. Your turn will come.
- 4. Watch Conditions: If the rare one is S4 at your QTH, but is passing out 40 over 9 reports to some other call area then chances are you can shout your head off for an hour with a Texas kilowatt and get no results. However, when he is 40 over 9 at your place you can frequently work him with 50 watts.
- 5. Keep Your Call's Short: If you call W9WNV/HKØ three times and then sign your own call three times, Don will probably make four more contacts before you finish generating QRM on the frequency.
- 6. Hear Him Before You Call Him: You may hear W4DQH working YK1AA, but that doesn't mean you can copy Rasheed at your QTH. However, you can sure make ORM for the ones who do hear him.
- 7. Don't Try to Ragchew With the Rare One: Many rare DX stations enjoy a good ragchew and it's certainly their privilege. Nobody wants to give nothing but RST's to W,K's all day long, but if he is working them contest style let him. It's up to him to decide when to stop and shoot the bull for a while.
- 8. Don't Tie Up the DX Station with Requests for an address; he could be making three or four more contacts. There are plenty of ways to lnd out an address, try the Callbook, the QSL Manager's Directory, your DX Association bulletin, or the listings in QST and CQ.
- 9. Avoid Long CQ Calls: These are a symptom of lid-itis. Short CQs by new DXers with only a short list of countries confirmed are justifiable, but good DXers spend most of their time listening. For Petes sake don't be the fink who calls CQ DX in the

middle of a pileup. This is the crowning mark of the number one lunkhead. and last but very, very far from least:

10. Always Keep Your Logs in Greenwich Mean Time (GMT): When a QSL manager sits down to make out three or four thousand cards he doesn't have time to convert Lower Slobbovian Daylight Saving Time to GMT. If he did it would take him four times as long and your precious card would probably end up in File 13.

This is really not the end. This list could keep going, doubtless you have thought of a few that I have missed. Worthy of note also are: Don't Tailend, Don't break the SSB station on 14.110 with CW when he says no CW please (Argh!!!), Don't ask the rare one to stand by for your buddy when there is a big pileup calling him, etc.

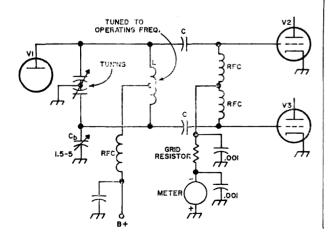
Happy DXing everybody. Really its a lot of fun.

. . . K4IIF

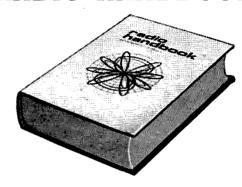
Capacitively-Coupled Phase Inverter

The most common phase inverter for rf is an inductively coupled transformer with the grid coil center tapped. However, at times it is difficult to use inductive coupling. The circuit shown is a method of phase inversion using capacitive coupling. Trimmer Cb is adjusted to approximately the output capacitance of V1 to balance the plate coil. Coupling capacitors C should be the same value. About 100 pF works fine on VHF and 500 pF on HF. On VHF the tuning capacitor should be a miniature butterfly. On the lower frequencies, a ganged tuning capacitor will work. I have had excellent results using this circuit.

. . . Larry Levy WA2INM



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SATURDAY, APRIL 15, 1967

WAMPLERS BALLARENA, DAYTON, OHIO

FOR INFORMATION, MAP, ACCOMODATIONS, WRITE:
DAYTON HAMVENTION, DEPARTMENT M, BOX 44, DAYTON, OHIO 45401

A Solid-State RTTY Indicator

So you've built that solid-state RTTY converter, and can't use it because you can't tune signals with it? The best way to tune is with a scope, but that \$60 and anyway, a scope is inconvenient to carry on demonstrations.

Well, here's a small, solid-state indicator for both mark and space. It uses two #47 light bulbs, four resistors, four 2N697 transistors and two 1N270 diodes. The unit is smaller and lighter than a silver dollar. I etched a copper-clad board and mounted the works on it, but a peg board would work just as well. Take your choice. Connect up as in Fig. 1, which shows only one of the two channels. They are identical except that R_L may be different. This resistor will have to be closed empherically. To adjust connect the completed unit to both the mark and space filters and to the power supply. Connect a 100 k Ω pot in place of each R_L and adjust for proper results on a received signal. The unit will trigger at approximately 0.02 mA and 3 V. I believe you will be very pleased with the operation of this unit, as I have.

. . . E. C. Sherrill K6JFP

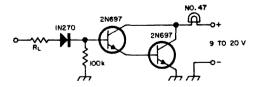
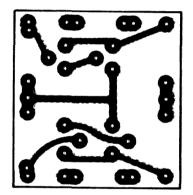


Fig. 1. Schematic diagram of one channel of the RTTY indicator.



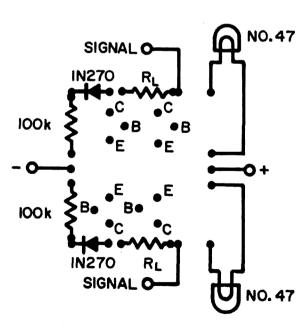


Fig. 2. Full-size drawing of the layout for the etched circuit board.



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THE VANGUARD 501 is a completely automatic closed circuit television camera capable of transmitting sharp, clear, live pictures to one or more TV sets of your choice via a low-cost antenna cable (RG-59U) up to a distance of 1000 ft without the need for accessories or modifications on the TV sets. The range can be extended indefinitely by using line amplifiers at repeated intervals or by using radio transmitters where regulations permit.

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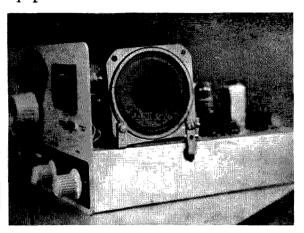
VANGUARD LABS

196-23 Jamaica Ave. Dept. S. Hollis, N.Y. 11423

Bullt-In Speaker

In the old days when it was fashionable for ham gear to be large and heavy, a separate speaker was the mark of a quality receiver. A separate speaker was also necessary to prevent howls from mechanical feedback.

Today we have rock stable equipment, and small speakers of good quality, and it is often possible to mount the speaker inside the equipment.



Here is a 3½ inch speaker installed in an HW-12. The little brackets are glued on with epoxy cement to avoid drilling holes. The wires were fed through the gap between the chassis and the front panel. No parts had to be moved, and all components are still accessible. The sound comes out through the ventilating holes, and the speaker cannot be seen. Although many speakers can be used, one with a one-ounce magnet will be louder. It makes little difference if it is 3.2 ohm or 8 ohm.

Having the speaker in the set means one less cable to disconnect when moving the rig from house to car.

. . . Edward Romney WA1FTV

WWV on the Drake R-4A

Users of Drake R-4A receivers may receive WWV on 5 MHz without buying additional crystals or modifying the unit. Set the band switch to 3.5, the preselector to about 5.3 and switch on the calibrator. Tune in the calibration signal with the VFO dial reading between 630-635 and peak with the preselector. Switch off the calibrator and under proper conditions WWV can be received.

. . . Bob Fransen VE6TW

Reduction of Transformer Voltage

Here's a neat trick to reduce the high voltage output of a power transformer a small amount when used as a transmitting plate transformer. It's especially useful when an old TV transformer from the junk box is pressed into service with a silicon diode voltage doubler or full wave bridge, and the resulting dc output voltage is found to be just a little too high for comfort, as is frequently the case.

Simply wire one or more of the unused filament windings in series aiding with the 117 volt primary winding to obtain the effect of a few more turns in the primary. Various combinations are possible because the 5.0 volt rectifier filament winding can be used to subtract from a 6.3 volt winding if only a small reduction is desired. The current rating of the filament windings is no problem because they are usually wound from much heavier gauge wire than the primary itself.

Caution: Don't try the reverse of this trick; that is, increasing the output voltage of an inadequate transformer by wiring the filament windings in series opposing. The extra voltage which would result would saturate the core iron, resulting in increased hysteresis losses in the core and excessive heating of the transformer. The only exception would be to correct for a known low input voltage, but care must be exercised not to exceed the rated voltage of the transformer secondary in any case.

This trick has been used very successfully here at K8SCM and frequently spells the difference between using an old "junker" transformer in a critical power supply or shelling out a lot of bucks to buy that special-order job which will furnish the exact voltage the schematics call for.

. . . John Copeland K8SCM



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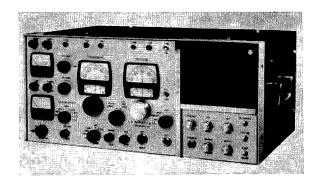
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High Frequency Single Sideband Receivers, Transmitters And Transceivers

Jim Fisk WIDTY Technical Editor



Babcock B-500-SSB Transceiver

The new Babcock B-550-SSB is claimed to be the world's most advanced transceiver, utilizing techniques that significantly extend the state of the transceiver art. This completely self-contained unit uses the advantages of modular construction and provides high efficiency performance on SSB, CW and AM.

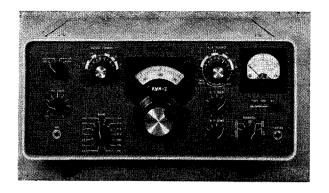
With the exception of the 12BY7A driver and 4CX250B final amplifier, all the circuits in the B-500-SSB use transistors or integrated circuits. A total of thirteen integrated circuits are used in conjunction with silicon transistors and diodes. The front end of the receiver uses two field effect transistors in cascode along with another FET in the first mixer. This combination results in

a noise figure of 4 dB, sensitivity of at least $0.5~\mu V$ on all bands and crosstalk rejection on the order of 96 dB.

The B-500-SSB covers all the ham bands from 80 through 10 meters in eight 500 kHz segments. Two precision VFO's are built in, and each provides calibration at the 100 Hz points. The receive VFO permits independent receiver for working out of band DX stations.

The power input on all bands is 600 watts PEP on sideband, 250 watts on CW and 500 watts PEP on AM with the optional B-500-AM plate modulator. For maximum efficiency and linearity, the final 4CX250B is run in class AB₁ on single sideband and in class C for AM and CW. The optional AM modulator is a plug-in unit which mounts conveniently inside the transceiver cabinet.

Other interesting features of the new Babcock B-500-SSB are the built-in supplies for both 115 Vac and 12.6 Vdc, a front end noise blanker which uses its own broadband if amplifier and noise gate, notch filter with notch tuning and depth controls, a level control to eliminate external attenuators when using a linear amplifier, built-in SWR meter, and front panel selection of ALC. For more information on this brand new transceiver, write to L. E. Babcock and Company, 28 Durant Avenue, Maynard, Massachusetts 01754.



Collins KWM-2

The Collins KWM-2 maintains a reputation for outstanding performance in mobile and fixed station applications; in fact, many of these units are being used by the Special Forces in Viet Nam. The KWM-2 will run 175 watts PEP input on SSB or 160 watts on CW, with a nominal output of 100 watts on all bands from 80 through 10. Crystals are provided for complete coverage of all the high frequency ham bands except ten meters, where only one crystal is supplied. There is provision for mounting two more crystals to extend the coverage on the 28 MHz band.

The Collins KWM-2 was the first available amateur mobile SSB transceiver and features a filter type SSB generator with a mechanical filter, automatic load control for boosting average talk power, a *linear* permeability tuned VFO and one kHz calibration on all bands. Compactness and efficiency are achieved by having all tuned circuits and several tubes serve dual roles in transmitting and receiving. For MARS and military applications, the KWM-2A is available. This unit has an additional crystal board which enables the operator to add 14 crystals to cover frequencies outside the amateur bands.

There is a complete line of accessories available for the KWM-2, including the 312B-4 speaker console which has a built in phone patch and directional wattmeter, the 516F-2 AC power supply, the PM-2 lightweight portable power supply, the MP-1 mobile power supply, the 351D-2 mobile mount, the very effective 136B-2 noise blanker and the 399B novice adapter. This latter accessory permits crystal control of the transmit frequency for novice operation.

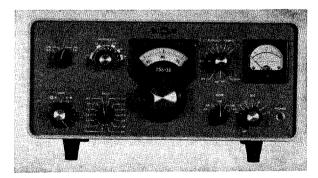


Collins 75S-3B Receiver

The Collins 75S-3B is a very versatile receiver with exceptionally sharp selectivity and operation on either SSB, CW, or RTTY. AM is also provided and the passband can be optimized by the installation of an optional 3.1, 4.0 or 6.0 kHz mechanical filter. In addition, two CW positions offer up to three degrees of selectivity in the CW/SSB mode with optional plug-in filters.

The 75S-3B can be combined with the 32S-3B transmitter to make a completely integrated station. When used with the 32S-3B, this receiver is capable of transceiver-type operation with the receiver VFO controlling the transmitting frequency. Coverage outside the amateur bands or additional 10 meter band coverage is obtained by plugging in the appropriate crystals.

Also available is the 75S-3C which provides extended frequency coverage. It is identical to the 3B except that an additional high frequency crystal board and front panel selector switch are included.



Collins 32S-3B Transmitter

The highly flexible 32S-3B transmitter covers all the amateur bands between 3.5 and 30 MHz with a power input of 175 watts PEP on SSB or 160 watts on CW. The nominal output on all bands is 100 watts. In the 32S-3B, the design engineers have

produced a transmitter with a minimum number of controls for precise tuning and maximum operational efficiency.

The 32S-3B is equipped with crystals for covering eleven 200 kHz bands to cover the ham bands from 3.5 to 30 MHz. Two additional positions are provided for extended coverage of the ten meter band and a third position may be used to cover an additional 200 kHz band in the 9.5 to 15 MHz range.

For CW use, grid block keying is used with adjustment of the characteristic from "soft" to "hard" to suit the individual operator. The 32S-3B may also be adapted to RTTY operation because of the high stability of the unit.

The Collins 32S-3B uses dual conversion with a linear permeability tuned VFO which offers the utmost in stability. The VFO may be used to control the transmit frequency, or when used with the companion 75S-3B receiver, to control the receive frequency. For improved linearity and reduction in distortion products, rf inverse feedback is used along with an automatic load control for higher average talk power.



Drake TR-4

The Drake TR-4 transceiver is engineered for optimum performance on upper or lower sideband, AM and CW. It is compact and lightweight, and is ideal for limited space, for mobile, for vacations or for portable excursions and DXpeditions. With 300 watts PEP input, it will give a good account of itself barefoot or will drive higher power ham linears. The RV-4 receiving VFO solves the problem of working DX and other stations operating on frequencies other than your transmitting frequency.

The TR-4 covers all the amateur frequencies between 3.5 and 30 MHz without the requirement of accessory crystals. In addition, either upper or lower sideband

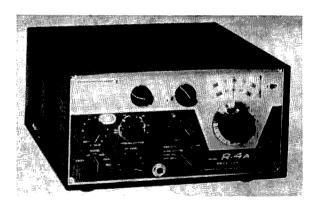
may be used on all bands with full VOX or PTT on both SSB and AM. For CW operation there is provision for automatic transmit and receive switching for semi break-in operation. A built-in CW sidetone oscillator provides monitoring of your CW signal.

The receiver exhibits a sensitivity of less than $0.5 \mu V$ for 10 dB signal to noise and provides full AVC on all modes; the audio output varies less than 3 dB for 60 dB change in signal level.

The sideband generator of the TR-4 uses two special 9 MHz crystal filters to provide upper and lower sideband selection on any band without the necessity of shifting oscillators. The filters are designed so that they are steeper on the carrier side, making sideband suppression of 40 dB and carrier suppression of 50 dB possible. For AM operation a controlled carrier AM screen modulator is built-in; the controlled carrier mode is compatible with SSB linear amplifiers.

On CW the power input is 260 watts and the carrier is shifted approximately 1000 Hz into one sideband. In the CW mode grid block keying is used to key the mixer and driver stages.

For operation from the 115 volt AC line the AC-4 power supply supplies all the necessary voltages. For mobile operation, the MMK-3 mobile mounting kit and 12 volt DC-3 DC power supply are available. For the deluxe installation, an MS-4 matching speaker may be used; this unit has space for mounting the AC-4 power supply in the rear.



Drake R-4A Receiver

The Drake R-4A receiver is a complete ham band receiver that covers all the frequencies on 80 through 15 meters and one 500 kHz segment of our ten meter band between 28.5 and 29.0 MHz. For additional coverage on ten meters or on other 500 kHz segments between 1.5 and 30 MHz, accessory crystals are available.

The R-4A features a tunable passband filter that provides selectable bandwidths of 0.4, 1.2, 2.4, and 4.8 kHz at 6 dB down. At 60 dB down the bandwidths are 2.6, 4.8, 8.2 and 25 kHz respectively. The sensitivity of this receiver is less than 0.5 μ V for 10 dB signal plus noise to noise and the AVC provides less than 3 dB change in audio with a 60 dB change in rf at the front end. In addition, the R-4A has excellent overload and cross modulation characteristics and is quite insensitive to the operation of nearby transmitters.

The Drake R-4A works on all modes, SSB, AM, CW and RTTY, with full rf gain, complete AVC action and accurate S-meter indication. Both the notch filter and 100 kHz calibrator are built in, and an excellent noise blanker provides excellent results on SSB. AM and CW.

The image rejection of the R-4A is greater than 60 dB and the internal spurious responses are less than the equivalent 1 μ V signal on the antenna. Also, if rejection is more than 60 dB. The combination of low spurious and image response along with excellent sensitivity and selectivity add up to an excellent receiver for amateur use.



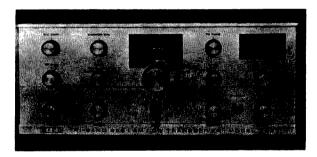
Drake T-4X Transmitter

The Drake T-4X is a complete sideband transmitter which may be used with the Drake R-4A for complete transceiver operation. The T-4X covers the ham bands from 80 to 10 meters with one crystal provided for ten meter operation from 28.5 to 29.0 MHz. Four additional accessory sockets are provided for complete coverage on ten meters or for four 500 kHz bands between 1.8 and 30 MHz. The VFO is a linear per-

meability tuned solid-state unit which is calibrated at the 1 kHz points on all bands.

The use of double tuned circuits and two special crystal lattice filters result in carrier suppression of 60 dB and unwanted sideband suppression of at least 40 dB above 750 Hz. In addition, the average distortion products are in excess of 30 dB down. The input power of the T-4X is 200 watts PEP on SSB and AM and 200 watts on CW. In the CW mode grid block keving is used and the built-in VOX circuit is keved for automatic transmit-receive switching for breakin operation. For RTTY operation, the VFO is easily adaptable to FSK. The signal frequency shifts the same direction and the same amount on all bands with a given dial setting.

The T-4 Reciter (receiver-controlled exciter) is similar in all aspects to the T-4X transmitter except that it does not have a built in VFO. When used with the R-4A, the T-4 provides completes transceive operation.



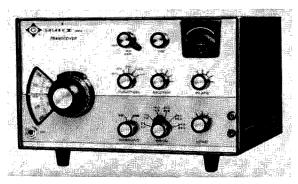
EICO 753

Although the modern sideband transceiver is a very complicated piece of equipment, it is not at all difficult to assemble the EICO 753 sideband transceiver kit. This transceiver has both PTT and VOX and the offset tuning allows you to move the receiver up to 10 kHz away from the transmit frequency. The engineering of this transceiver leaves little to be desired, and the step-by-step instructions are clear and easy to follow. At a time when so much amateur equipment is being bought factory wired, the ham who constructs his own from a kit can feel well satisfied.

The full-band coverage of the 753 actually goes beyond the band edges: 3490 to 4010 kHz, 6990 to 7310 kHz and 13890 to 14410 kHz with lower sideband on 40 and 80 and upper sideband on 20. The VFO is completely solid state and is very stable for either

fixed or mobile operation. Complete VOX is built in with the VOX threshold, delay, sensitivity and anti-VOX controls available on the rear deck.

The power output, 120 watts PEP, is sufficient to drive any linear amplifier, and when used barefoot will give an excellent account of itself. The high level dynamic ALC circuitry controls splattering and flattopping as well as linear amplifier loading. For the ham who doesn't want to roll his own, EICO has conveniently made a factory assembled version available for \$299.95.



Galaxy V Mark 2

The new Galaxy V Mark 2 transceiver maintains all of the features of the old model, but adds some new things to make a very nice package better. This new transceiver is rated at 400 watts PEP in SSB service, up 100 watts from the old model, has a new precise vernier logging scale that lets you interpolate accurately down to 50 Hz or so, a solid state VFO for improved frequency stability and drift and a built-in audio sidetone for the CW boys. In addition, there is a new CW filter and break-in option available if you want the maximum in CW operating convenience.

The excellent sensitivity of the Galaxy V, less that $0.5~\mu V$ for 10~dB signal to noise ratio, and the extremely good shape factor of the *if* passband provide very good results on our crowded bands. The dual attack and release AVC make the receiver virtually block proof. For increased power and minimum flat-topping and distortion, the internal ALC circuit provides up to 10~dB of compression.

This unit is lightweight and compact, and is an ideal choice for mobile operation. For mobile use, the G35A DC supply furnishes all the necessary voltages; for fixed station use, the AC35 AC power supply is available.

Other accessories which are available are a remote VFO for working stations off your transmit frequency, a deluxe accessory console which has a built-in speaker, phone patch, SWR bridge and 24 hour digital clock, a speaker console which has provision for mounting the AC power supply, and several accessories for mounting the Galaxy V Mark 2 in your car.



Hallicrafters SR-500 Tornado

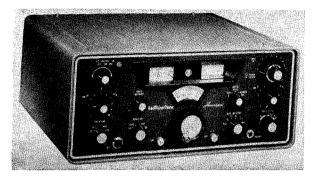
The Hallicrafters SR-500 Tornado transceiver provides the amateur with high-performance SSB and CW operation on the three most popular ham bands; 80, 40 and 20 meters. Lower sideband is used on 80 and 40 meters and upper sideband on 20. The 500 watts PEP input of this transceiver provides an excellent account of itself when run "barefoot."

The transceiver incorporates Hallicrafters' exclusive Amplified Automatic Level Control (AALC) to prevent splatter and final amplifier flat-topping. In addition, the receiver section contains Receiver Incremental Tuning Control (RIT) which allows the operator to tune the receiver up to 3 kHz to either side of the transmitter frequency. All jacks and switching for linear amplifier operation are included as well as a combination S-meter/RF output indicator.

The dial is calibrated in 5 kHz increments, and these are accurate to within 2 kHz between the 100 kHz points when used with an optional crystal calibrator. The stability of the VFO is excellent, and is stable to within 300 Hz after warmup.

Accessories available for the SR-500 include the HA-16 VOX adapter, the P-500 AC power supply for fixed station operation

and a P-500 DC power supply for mobile operation from a 12.6 volt DC power source. For mobile installations the special MR-160 mobile kit is available which includes all the inter-connecting cables.



Hallicrafters SR-2000 Hurricane

The Hallicrafters SR-2000 Hurricane may well be the world's most powerful transceiver-it runs a full 2000 watts PEP input on single sideband. This transceiver has many interesting features in addition to its full legal power rating. A linear gear driven VFO is provided which has less than 1 kHz readout; receiver incremental tuning for working stations off the transmit frequency, built-in amplified automatic level control (AALC), built-in VOX plus CW break-in and PTT. The use of double tuned circuits and steep sided crystal filters results in improved spurious signal rejection and carrier suppression of 50 dB, unwanted sideband suppression of 50 dB and 30 dB suppression of the 3rd and 5th distortion products.



Hallicrafters HT-46

The Hallicrafters HT-46 SSB/CW transmitter provides a potent input power of 175 watts PEP on SSB and 150 watts on CW. It is outstanding as a separate transmitter with a self contained AC power supply, but

its extra versatility is shown by the transceiving capability provided for use with the matching SX-146 receiver. In addition, it may be operated separately from its own internal VFO. Physically it is the same size and appearance as the SX-146 receiver, so it makes an ideal companion to it.

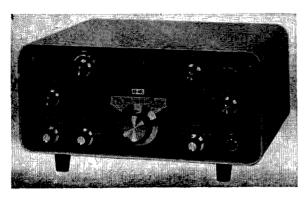
The HT-46 transmitter features advanced crystal filter sideband generation at 9 MHz and selectable sideband operation on all bands. Although only 500 kHz of the ten meter band is provided, accessory crystals are available to cover the complete ten meter band. For use on CW, the grid block keying circuit provides exceptional keying qualities.



Hallicrafters SX-146

The Hallicrafters SX-146 receiver features an advanced design which employs single conversion to a high frequency crystal filter for selectivity. A premixed oscillator chain assures a high order of frequency stability and minimizes adjacent channel cross modulation products. This receiver is supplied with crystals for all the ham bands from 80 to 15 with a 500 kHz segment on ten meters, but the connection of auxiliary oscillators will permit its use from 2 to 30 MHz, except for a small region around 9 MHz, the frequency of the crystal filter. Crystals are available from the manufacturer for complete coverage of the ten meter band.

The selectivity of this receiver as supplied by the factory is 2.1 kHz at the 6 dB points, but optional filters 0.5 kHz and 5.0 kHz wide are available for CW, RTTY and AM operation. The SX-146 provides selectable sideband, a very effective noise limiter and good sensitivity. For transceiver operation, the SX-146 may be used in conjunction with the Hallicrafters HT-46 5 band transmitter.

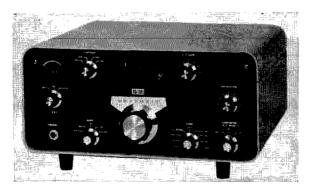


Heathkit SB-401 SSB Transmitter

The Heathkit SB-401 SSB transmitter may be used with the SB-301 receiver for full transceive operation or it may be used independently. The SB-series combination goes from transceive operation to independent transmitter-receiver operation with a flip of a single switch on the SB-401 front panel.

The SB-401 transmitter employs compactron tubes for space-saving component layout, and heavy-duty circuit board construction plus precut wiring harness permits fast assembly and assures stable operating characteristics. For maximum protection from TV interference, all the circuits are completely shielded and isolated.

The VFO in the SB-401 is the same type of linear master oscillator used in the SB-301 receiver. In addition, the SB-401 features built-in ALC, antenna changeover relay, upper or lower sideband selection, 1 kHz dial calibration and full coverage of the amateur bands from 3.5 to 30 MHz.



Heathkit SB-301 Receiver

The new Heathkit SB-301 raises the standards for amateur band receivers and brings full RTTY reception capability to the SB-series plus full coverage of the amateur bands from 80 through 10 meters. In addi-

tion, a 15 to 15.5 MHz tuning range enables the most accurate attainable frequency checks with WWV. The outstanding noise limiter used in the SB-301 provides impulse noise rejection for the receiver and signals in high noise locations are easily readable.

Other features of the SB-301 are the prebuilt linear master oscillator (LMO) which provides receiver tuning with bandspread equivalent to 10 feet per MHz. In addition, it is linear over the entire receiver coverage.

When used with the SB-401 SSB transmitter, the SB-301 provides full transceive operation. The high sensitivity of this receiver, less than 0.3 µV for 10 dB signal-plus-noise to noise, plus the selectivity of 2.1 kHz provide excellent performance. For the RTTY and CW operator, optional crystal filters are available which provide selectivity of 3.75 kHz and 400 Hz respectively at 6 dB down.



Heathkit SB-100 Transceiver

The Heathkit SB-100 transceiver is rated at 180 watts PEP SSB and 170 watts CW with full coverage of the fine ham bands below 30 MHz. The sideband generation circuitry of the SB-100 features a six pole crystal lattice filter which produces a superior 2:1 shape factor and symmetrical passband which results in sharper receiver tuning, greater sideband suppression, and identical characteristics on both upper and lower sideband signals. The carrier is down 50 dB from single tone output, the unwanted sideband is suppressed more than 55 dB and the third order distortion products are 30 dB down.

The new Triple Action Level Control (TALC) uses three separate circuits to provide greater speech compression; is service

the TALC circuit results in 10 dB of speech compression with 0.1 mA final grid current. The use of a linear master oscillator (LMO) provides linear and smooth tuning with 1 kHz calibration on all bands. Both VOX and PTT are built into the SB-100 as well as semi break-in operation for CW; a CW sidetone is also provided.

For operation at a fixed station, the 115 volt HP-23 AC power supply is available. For mobile installations, the HP-13 DC power supply and SBA-100-1 Mobile Mounting Kit will make things easy.

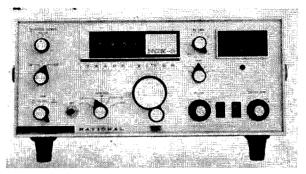


Heathkit 12A, 22A, and 32A Single-Band Transceivers

These new versions of the SSB transceiver that opened up a whole new era in amateur radio have several interesting features. Heath has gone all out to give the radio amateur greater economy and better performance in their famous single-banders. Foremost among the new features of this series is the selectable upper or lower sideband.

In addition the microphone input and gain control, plus bias adjustments are now located on the front panel for ease in changing from fixed station to mobile operation. An added function switch position controls the optional 100 kHz crystal calibrator and the power connectors are now fully compatible with the Heath SB-series power supplies.

The receivers in these new units feature 1 µV sensitivity for 15 dB signal-plus-noise to noise ratio and 2.7 kHz selectivity. The modern crystal filter provides more than 45 dB of carrier and unwanted sideband suppression and the slow AVC action provides optimum SSB reception.



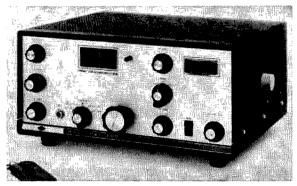
National NCX-5 Mark II

The National NCX-5 Mark II transceiver features 200 watts PEP on sideband, 200 watts CW and 100 watts AM on the popular ham bands from 3.5 to 30 MHz. The 1 kHz dial calibration is accomplished with a technique previously used only in the most expensive laboratory or military equipment—a digital readout in kHz on each amateur band with additional counter calibration to 100 Hz. The tuning rate of 10 kHz per knob revolution is identical on all bands and parallax is zero.

The NCX-5 is a double conversion unit with crystal controlled high frequency oscillators on each band and a *linear* solid state VFO. The use of a transistorized VFO eliminates many of the thermal instabilities of vacuum tubes and provides stability from a cold start which is equivelant to that of the best tube-type oscillators after warm-up.

The excellent selectivity characteristics of the NCX-5 are obtained through the use of an eight pole crystal lattice filter. This filter has a shape characteristic of 1.7:1 and 60 dB down the passband is only 4.76 kHz wide; at the 6 dB points the passband of 2.8 kHz uses a minimum of spectrum consistent with pleasing voice quality. With the crystal filter and balanced modulator used in the NCX-5, the carrier suppression is 50 dB, the unwanted sideband suppression is 50 dB and third order distortion products are 30 dB down.

The NCX-5 incorporates selectable sidebands on all ham bands along with transceiver vernier tuning to permit 5 kHz tuning of the receiver independently from the transmitter. For DX operation, the optional VX-501 digital dial VFO is available. The NCX-5 may be operated either with VOX or PTT on both AM or SSB or with grid-block semibreak-in keying on CW. For AM operation a separate AM detector and AM carrier insertion is provided. The National NCX-5 incorporates two rf stages in the receiver section for increased sensitivity and spurious signal rejection, and the fast attack, slow release AVC system provides smooth, clean SSB/CW reception without distortion, clicks, pops or thumps. For the deluxe installation, oiled walnut cabinets are available for the NCX-5, the VX-501 external VFO and the NCX-A AC power supply.



National 200

The new National 200 transceiver gives the radio amateur complete SSB, AM and CW coverage of 80 through 15 and 600 kHz between 28.5 and 29.1 MHz on ten meters at a very reasonable price. For complete coverage of the 10 meter band two additional crystals may be obtained from the National Radio Company. This new transceiver features 200 watt PEP input on all bands. The fast attack, slow release AVC system works on all modes, SSB, CW and AM. For optimum performance, separate product detector and AM detection circuits are used.

To maintain high stability and the same tuning rate on all bands, a premixed crystal controlled front end arrangement is used. The selectivity obtained from the crystal lattice filter is excellent and results in a shape factor of 2.2:1 for high sideband suppression on transmit and rejection of adjacent channel QRM on receive. The solid state balanced modulator used in the National 200 results in more than 50 db of carrier suppression. Third order distortion products are suppressed more than 30 dB at full output and the unwanted sideband is suppressed 40 dB.

The extremely smooth tuning mechanism uses a 45:1 planetary and split gear drive; the dial is calibrated every 5 kHz. For AM and CW operation, the carrier is automatically inserted when switching to these modes. For maximum talk power on SSB and AM, an internal ALC circuit is pro-

vided; an external ALC input is available for use with higher power linear amplifiers.



Sideband Engineers SB-34

The SB-34 transceiver is a complete four band transceiver for 80, 40, 20 and 15 meters, with built-in power supplies for both 115 volts AC and 12 volts DC. The SB-34 is almost completely transistorized with 23 transistors and 20 diodes; the only vacuum tubes used are in the final power amplifier and driver stages. In addition to the built-in power supplies, all the necessary inter-connecting cables are provided with each unit. Since a front panel mounted speaker is included, only a suitable antenna and a microphone are required to put the SB-34 on the air

This transceiver uses a Collins 2.1 kHz mechanical filter for excellent receiver selectivity and a sharp, clean sideband signal. There are no relays inside the SB-34; all the transmit-receive switching is accomplished with solid state circuitry. The VFO tuning dial employs a dual speed mechanism which allows fast dial movement to the desired portion of the band and smooth slow speed drive for positive vernier tuning of a single sideband signal. The sidebands are completely selectable from the front panel and a offset tuning control allows the receiver to be tuned up to 2 kHz from the transmitting frequency.

On DC operation the transmitter filaments may be switched off with a front panel switch for low current operation of the receiver portion. This type of operation is especially desirable for portable or emergency operating conditions; the transceiver only requires 500 mA at 12 volts DC in this standby-receive mode.



Swan 350 and 400

The Swan 350 transceiver is a complete coverage 5-band unit providing SSB, AM and CW; its companion is the Swan 400. The 350, with an appropriate power supply is a complete package requiring only a microphone and an antenna; the 400 requires an external VFO in addition to a power supply, microphone and antenna. The 350 was designed to be a basic transceiver, providing the means for the owner to add the accessories of his own choice.

Accessories available for the Swan 350 include a 100 kHz calibrator, selectable sideband kit, and transistorized VOX. On the other hand, the Swan 400 includes the

calibrator, selectable sideband, built-in speaker and VOX but does not include the VFO. There is a choice of three different VFO's for the model 400, the model 410 which is essentially the same as the VFO used in the 350, the MARS oscillator which provides operation on any crystal controlled frequency between 3 and 30 MHz and the mobile model 406B VFO. The 406B is actually a combination control box and VFO and when used with the Swan 400 permits remote control of a trunk mounted transceiver in your car. It includes the VFO as well as an rf gain control, microphone jack and bandswitching. Any one of these VFO's may be used with the Swan 350 to provide transmit-receive functions on different frequencies.

The power supplies available for the Swan transceiver are also quite extensive. The standard AC supply, the model 117XC is probably the most popular supply, because it is a very husky unit that may be used mobile with the proper Swan conversion kit. For negative grounded cars (12 volt) the model 14X kit is required; for positive grounded cars, the model 14XP is used. These conversion kits are simply modules which plug into the back of the standard 117XC power supply. For the operator who wants to operate mobile only, Swan also has a DC power supply available, the model 14-117.

Recent Transceiver and Linear Amplifier Reviews

"The Drake R-4 Receiver", WA2TDR, 73, January 1966, page 78.

"Drake L-4 Linear", W1DTY, 73, February 1967, page 90.

"The EICO 753K", W3KET, 73, January 1966, page 76.

"Galaxy V", W2NSD, 73, April 1965, page 78.

"Heathkit SB-100", K2EQB, 73, August 1966, page 50.

"The Heath SB-200", WA2TDH, 73, January 1965, page 78.

"The Heathkit SB-300 Receiver," WA2TDH,

73, August 1964, page 66. "The Heath SB-400", K1RPB, 73, September 1964, page 64 and October 1964, page 91.

"Heath HW-22 SSB Transceiver", WA2TDH, 73, January 1964, page 74.

"The Little Bomb", (Heath HA-14 KW Kom-

pact), WB6KEH, 73, October 1965, page 88. "Henry 2-K Linear", W2NSD/1, 73, June 1965, page 28.

"National 200", W1DTY, 73, February 1967, page 104.

"NCX-3 by National", W2NSD/1, 73, April 1963, page 78.

"National NCX-5", W5DWT, 73, October 1965, page 84.

"National NCL-2000", W1ALU, 73, October 1964, page 92.

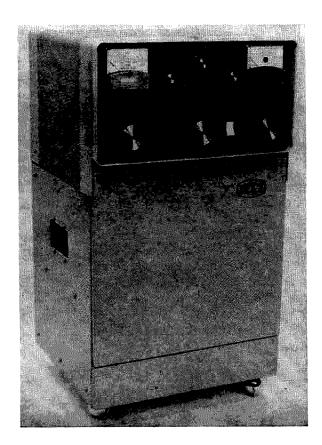
"The SB-34", W8QUR, 73, August 1965, page 68.

"Swan 350", WB6DEH, 73, February 1965, page 82.

"Transcom SBT-3 Transceiver", W2NSD/1, 73, November 1965, page 86.

"WRL Duo-Bander 84", W8QUR, 73, October 1966, page 74.

High Frequency Single Side Band Linear Amplifiers



BTI LK-2000

The BTI LK-2000 is a single tube, grounded grid linear amplifier built to really take it and loafs along at the full legal input. This amplifier is offered in two styles—the floor model console, or the two-unit table top model with a separate power supply. Either model is convertible into the other with a few available conversion parts.

The amplifier tube is the quick-heating Eimac 3-1000Z which has a full 1000 watts plate dissipation and replacement cost of only seventy-eight dollars. More than adequate cooling is provided by using the recommended air cooled socket and chimney along

with a very quiet blower. A unique after cooling feature has been incorporated in the BTI LK-2000 which keeps the blower running from 60 to 90 seconds after the amplifier is turned off.

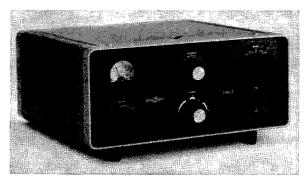
The solid state power supply is built around a husky 40 pound plate transformer; computer grade capacitors provide 30 uF of output capacitance. The combination of a solid state power supply and quick-heat-tube permit almost instant on and off—no warm-up waiting is required. For filament power to the 3-1000Z, a separate filament transformer is mounted in the rf section.

Drive to the 3-1000Z is applied through low-Q broad band tuned input circuits; not over 100 watts of drive is required for full power operation. The LK-2000 performs quite well with only 50 watts of drive and under these condition provides 1500 watts PEP input. Although the cathode input circuits are tuned for amateur band phone operation, they may be retuned by the user for operation at other frequencies with the instructions furnished.

A pi-L output circuit is used to match the plate to the antenna; the pi-L is preferred over the simple pi circuit because of its improved harmonic attenuation. To assure maximum shielding, all cabinet joints of the rf section are alumi-gold processed.

The ALC circuitry used in the BTI LK-2000 provides many distinct advantages; when adjusted according to the instruction manual, the ALC will prevent distortion from overdriving in either the amplifier or the exciter. It allows much freedom in mouth-to-mike distance while maintaining the same full output. Even when you get a little excited and shout, the ALC instantly adjusts the level to prevent distortion.

Either 115 or 230 volts is required for the power supply. An overload relay in the plate current circuit turns off the main power relay when plate current exceeds one ampere. An accessory dummy load is available which will take the full output of the transmitter for several minutes during tune up. A control knob on the front panel of the amplifier switches from the antenna to the dummy load; a thermal switch in the load will automatically turn off the amplifier if the load reaches it maximum rated temperature.



Collins 30L-1

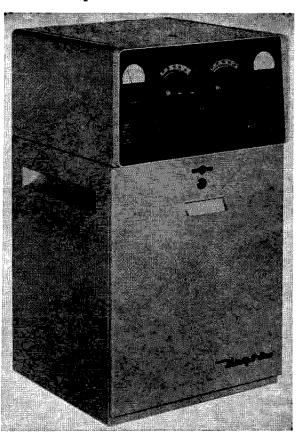
The Collins 30L-1 linear amplifier is rated at 1000 watts PEP on SSB and 1000 watts average on CW on all bands; it may be easily driven to its fulled rated input by any 70 to 100 watt exciters. This unit is completely self contained and designed for table top use.

Although the 30L-1 was designed specifically for SSB and CW service on the amateur bands from 3.5 to 30 MHz, provisions are made for general coverage use too. The ALC voltage from the 30L-1 linear is fed back to the exciter, providing maximum talking power without overdriving and distortion. In combination with rf inverse feedback, the ALC circuit provides more average power with a sharper sounding signal.

The 30L-1 uses four 811A triodes in the grounded grid configuration. Since the 811A's are instantly heated, there is no delay in warm-up.

In addition to indicating plate current and plate voltage, the panel meter is connected into a special comparator circuit. In the "tune" position, the amplifier is optimumly tuned when the tuning and loading controls are adjusted to zero the meter.

For safety, both the rf and power supply compartment covers operate safety interlock switches. Cover removal closes these switches and shorts the high voltage to ground. This arrangement protects the operator from accidentally coming in contact with the high voltage dc which is present in both compartments.

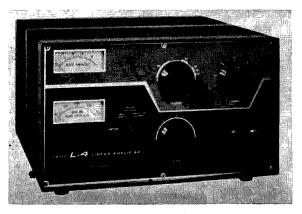


Collins 30S-1

The Collins 30S-1 requires only 70 to 100 watts of driving power to provide the full legal input of 1000 watts (average) on SSB and 1 kW on CW transmissions. This amplifier is completely self-contained and uses the commercially popular 4CX1000A as a grounded grid linear amplifier.

All the controls for operating the 30S-1 are conveniently located on the front panel permitting fast and efficient band changes. With the simple push of a button you can switch from the 100 watt power level of your exciter to the full kilowatt output of the 30S-1.

To assure maximum talking power and minimum distortion, the ALC voltage from the 30S-1 is fed back to the exciter. This, incombination with rf inverse feedback, provides a very clean and sharp signal. Correct tuning and loading are indicated by a zero reading on a full scale multimeter; the loading control and PA tuning control are simply adjusted to obtain zero meter indication.



Drake L-4

There's nothing halfway about the Drake L-4 linear amplifier; this unit is built for continuous duty at full capacity. The rating of 2000 watts PEP on SSB and 1000 watts on CW, AM or RTTY is ensured; the massive plate transformer, heavy duty tank components and voluminous cooling system make continuous operation at these ratings possible.

The power amplifier uses two 3-400Z or 8163 zero bias triodes in a class B grounded grid circuit. These two tubes have a total plate dissipation of 800 watts and their rugged construction will withstand a lot of abuse. For minimum distortion, higher efficiency and a constant 50 ohm input impedance, the cathodes of the 3-400Z's are matched with broadband tuned input circuits.

Any exciter that will deliver 100 watts PEP SSB and 75 watts on CW will drive the L-4 to the maximum legal input power. In the grounded grid configuration, most of the driving power is added to the output power. The use of a transmitting AGC circuit controls the exciter gain to allow a higher audio level without peak clipping. In addition, rf feedback is used to decrease distortion to better than 35 dB and tends to equalize tube characteristics from tube to tube.

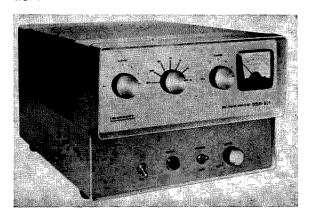
Galaxy 2000

The unique new design of the Galaxy 2000 permits the use of ten parallel 6HF5 tubes to deliver high efficiency, even on ten meters. In fact, the power output on all bands is guaranteed to be at least 1200 watts PEP. These tubes are easily obtainable and their total replacement cost makes them very attractive for linear amplifier use. In

the Galaxy 2000 the 6HF5's operate well within the manufacturer's voltage, current and temperature specifications.

The Galaxy 2000 operates in class AB₁ and delivers a very clean and stable signal. The amplifier incorporates both voltage and current monitoring, with an FCC specified time constant meter, as well as a tune position which monitors the rf output of the amplifier. The automatic linearity system (ALS) circuit used in the Galaxy 2000 provides automatic comparison of the inputoutput waveform, and acts on this information to maintain exact waveform duplication with best linearity.

The Galaxy 2000 features a compact table top design with built-in antenna changeover relay, heavy duty solid state power supply, and reduced power input in the tune-up position. Any exciter in the 100 to 200 watt class will drive the amplifier to full rated input and only a single ground of the operating control circuit is required for operation.



Gonset GSB 201

Exceptionally compact—only 8½" high, 12%" wide and 17" deep—the GSB-201 lends itself readily to table-top mounting. Finished in blending light greys, it presents a handsome, clean-cut appearance.

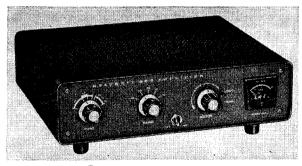
The Gonset GSB linear amplifier provides 10 dB gain on the 80, 40, 20, 15, and 10 meter bands with maximum input power of 2000 watts PEP on SSB, 1000 watts CW or 400 watts AM. It will operate with nearly any SSB exciter, homebrew or commercial; 100 watts PEP drive will provide the maximum of 1000 watts PEP output. The GSB 201 incorporates a number of desirable operating features which include the use of four low cost 811A tubes in stable, grounded grid circuitry. The power supply uses mod-

ern silicon rectifiers and an antenna changeover relay is built in. A panel switch permits preliminary tuning to be done at low power levels, thereby reducing interference. The plate current meter is switchable from the front panel to indicate plate current or relative power output.



Hammarlund HXL-1

The Hammarlund HXL-1 1500 watt PEP linear amplifier provides an excellent match to lower powered SSB exciters and provides 1500 watts PEP on SSB, 1000 watts on CW and 250 watts in AM service. This efficient linear uses a pair of 572A/B triodes in a bandswitching arrangement that covers all the ham bands from 80 through 10 meters. This amplifier features an internal power supply, built-in antenna changeover relay, pi net output circuit and a multipurpose meter which has been provided with a built-in circuit that even provides a linearity test.

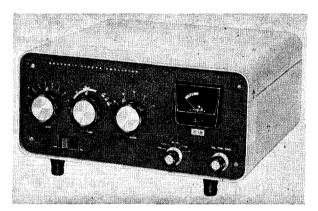


Heath KW Kompact

Interested in a kilowatt mobile? How about a small table top linear? The Heath-kit HA-14 KW Kompact may be just what you're looking for. This miniscule little box will provide up to 1000 watts PEP on all bands from 80 through 10, yet is only 3% inches high, a little over a foot wide and ten inches deep. It is small enough to be mounted under the dash of nearly any car

with plenty of room to spare-room enough in most cars to allow it to be stacked with your transceiver, providing a complete under-the-dash mobile kilowatt station.

Two 572-B/T-160-L's operating in parallel in the final provide a clean signal with third order distortion products 30 dB down at 1000 watts PEP input. A built-in SWR meter and antenna changeover relay add to the operating convenience. In addition, the broad band input circuits on each band require no tuning. Also, provisions for remotely controlling the power supply used with the KW Kompact should appeal particularly to the mobile operator.

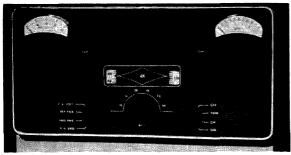


Heathkit SB-200

The Heathkit SB-200 desk-top linear amplifier is a complete self-contained unit that provides 1200 watts PEP input on SSB and 1000 watts on CW. This unit has its own built-in power supply and any exciter with 100 watts PEP output will provide adequate drive. Two heavy-duty 572-B/T-160-L final amplifier tubes provide an extremely clean signal with minimum distortion.

For maximum efficiency and low distortion, pretuned cathode input circuits are used. These, along with ALC within the SB-200 and provision for external use of the automatic level control result in a relatively constant audio output under varying conditions. The amplifier is completely shielded for TVI protection and stability and a builtin SWR meter and antenna changeover relay provide the maximum in operating convenience.

The conservatively rated power supply uses silicon diodes for maximum reliability and is circuit breaker protected (no fuses to worry about). In addition, this supply may be operated from either 115 or 230 volts ac, 50/60 Hz.



Henry 2-K

The Henry 2-K linear amplifier uses two rugged 3-400Z grounded grid triodes which were especially designed for zero-bias linear operation. These tubes provide 800 watts of plate dissipation and the full legal limit in all modes—2000 watts PEP on SSB and 1000 watts on CW, AM, and FSK.

The Henry 2000 watt linears are available in two models, the console model 2K-2 and the desk model 2KD-2 which has an external power supply. If you have your own power supply, the rf deck is available separately as the 2KR-2. The power supply used in these units is a heavy duty 2500 volt dc supply which is rated very conservatively. A choke input filter provides very good regulation and the solid state rectifiers insure year-in, year-out reliability.

For greatest efficiency and maximum attenuation of unwanted signals the pi-L plate circuit uses a silver plated tank coil. The band switch is a rugged unit with 20 ampere contacts and solid straight-through linkage. In addition, heavy duty bronze gears are used to drive the tuning capacitors. An aluminum cabinet eliminates any magnetic resonances and double rf shielding minimizes harmonic radiation. In fact, the second harmonic is more than 60 dB down from the full rated input.

To obtain maximum drive and maintain linearity, a resonant cathode-pi input circuit is used. The special plug-in design permits operation on any frequency from 3.5 to 30 MHz. The built-in SWR meter and rf output meter simplifies tuning up while allowing the operator to monitor the performance of his antenna.

In addition to the 2K line of linear amplifiers, Henry has just announced the new 4-K "Commercial" unit. The 4-K employs the 5CX1500A power pentode which is designed for superior linearity. This tube provides a full 4000 watts PEP input on SSB with efficiencies in the range of 60%.

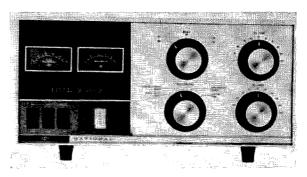


Hunter Bandit 2000B

The Hunter Bandit 2000B linear amplifier is designed for operation with SSB transceivers providing 100 watts PEP output. However, the output of the exciter may be substantially higher without harming the linear amplifier. This means that most modern SSB transceivers are compatible with the Bandit.

Four UE572B triodes are used in the power amplifier; these tubes provide 2000 watts PEP input on SSB. There is no warm-up period required because the filaments of these tubes are instant heating and the solid state high voltage power supply provides instant power. When the linear is turned off, the exciter is connected directly to the antenna through the internal antenna change-over relay.

A separate adjustable rf output meter is included in the output circuit of the 2000B. This meter permits the operator to adjust the measuring circuit to accommodate different feedline impedances and to adjust sensitivity on all bands. This meter is particularly interesting in that it follows the modulation envelope much like a VU meter and provides an excellent modulation monitor.



National NCL-2000

The National NCL-2000 covers all the amateur bands from 80 through 10 meters

and includes a husky built-in 115/230 volt AC power supply. The full key down power on CW, AM and RTTY is 1000 watts, with 2000 watts PEP on SSB for the full legal limit. The two 8122 ceramic tubes used in the final were designed specifically for single sideband service and provide 800 watts of plate dissipation to assure conservative operation. The output of the NCL-2000 is very clean with the third and fifth order distortion products down 30 or 45 dB respectively; in addition, hum and noise are more than 40 dB down and the full rated input.

The use of grid regulated class AB₂ operation results in high efficiency and linearity along with easy tune-up and low drive requirements; the NCL-2000 may be driven to full rated input with any exciter delivering 20 to 200 watts PEP. The NCL-200 is protected against overload and the operator against electrical shock with the built-in safety devices. In addition to fuses, time delay and plate current overload relays, a plate power lid interlock and automatic high voltage shorting bar are included.



Sideband Engineers SB2-LA

The compact SBE SB2-LA linear amplifier operates at 1000 watts PEP input on 80 through 20 meters and 750 watts PEP on 15 meters. Although the SB2-LA was designed as a companion unit to the SBE 34 transceiver, it will boost the output of any SSB transceiver up to a full kW PEP.

The input circuit of the SB2-LA uses a passive grid input circuit which offers a pure resistive load to the exciter. In the output a pi network provides matching to the transmission line with band switching from the front panel.

The built-in 115 volt ac supply is a voltage multiplying type unit; the high capaci-

tance filter capacitors provide excellent dynamic regulation. The low plate voltage—800 volts—is used with a relatively high current level. This arrangement is easier on the capacitors, rectifiers, power transformer and six parallel connected 6JE6's used in the final.

The SB2-LA has two built-in antenna changeover relays and internal blocking bias to prevent diode noise when receiving. For mobile operation the SB3-DCP inverter is available for powering the SB2-LA from a 12 volt source. The output of the inverter is 120 volts ac at 1200 watts; in mobile service the internal ac power supply is used.



Swan Mark 1

The new Swan Mark 1 linear amplifier uses two 3-400Z or 8163 zero bias triodes in a grounded grid circuit for convervative maximum legal input rating. A built-in power switch reduces the input to 1000 watts dc for CW and tune-up. The untuned input circuit provides the maximum in operating ease and permits very fast and wide range frequency changing.

The built-in 2500 volt solid state power supply may be powered from either 115 or 230 volts ac. It is very conservatively rated and the use of semiconductor rectifiers provides extended trouble-free operation. The tube cooling concept used by the Swan engineers guarantees long tube life and reduces initial equipment cost.

Dual change-over relays automatically switch the exciter in and out of the transmission line. The wide range pi-output network allows the Mark 1 linear to be used with a variety of antenna systems without the necessity of external matching networks. The metering of grid current, plate current, plate voltage and relative rf output permits monitoring of all the essential parameters and maximum tune-up ease.

. . . W1DTY

	Frequency Coverage									
Model	. 80	40	20	15		10)			
Babcock B-500-SSB	3.5-4.0	7.0-7.5	14.0-14.5	21-0-21.5	28,0-28.5	28.5-29.0	29.0-29.5	29.5-30.0		
Collins KWM-2	3.4-4.0	7.0-7.4	14.0-14.4	21.0-21.6	28.5-28.7	1				
Collins 75S-3B	3.4-4.0	7.0-7.4	14.0-14.4	21.0-21.6	28.5-28.7	1				
Collins 32S-3B	3.4-4.0	7.0-7.4	14.0-14.4	21.0-21.6	28.5-28.7					
Drake T-4 Reciter	3.5-4.0 ²	7.0-7.52	14.0-14.52	21.0-21.52	28.5-29.0 ²					
Drake T-4X Transmitter	3.5-4.0	7.0-7.5	14.0-14.5	21.0-21.5	28.5-29.0					
Drake TR-4	3,5-4.1	7.0-7.6	13.9-14.5	21.0-21.6	28.0-28.6	28.5-29.1	29.1-29.7			
Drake R-4A Receiver	3.5-4.0	7.0-7.5	14.0-14.5	21.0-21.5	28.5-29.0					
EICO 753	3.49-4.01 L	6.99-7.31 L	13.89-14.41 U	-	-					
Galaxy V Mk II	3.5-4.0	7.0-7.5	14.0-14.5	21.0-21.5	28.0-29.5					
Hallicrafters HT-46	3.5-4.0 ⁸	7.0-7.53	14.0-14.53	21.0-21.58	28.0-28.58	28.5-29.08	29.0-29.58	29.5-30.08		
Hallicrafters SX-146	3.5-4.0	7.0-7.5	14.0-14.5	21.0-21.5	28.0-28.54	28.5-29.0	29.0-29.54	29.5-30.04		
Hallicrafters SR-500	3.5-4.0 L	7.0-7.5 L	14.0-14.5 U							
Hallicrafters SR-540	3,5-4.0	7.0-7.5	14.0-14.5	21.0-21.5	28.0-28.54	28.5-29.0				
Hallicrafters SR-2000	3.5-4.0	7.0-7.5	14.0-14.5	21.0-21.5	28.0-28.54	28.5-29.0	29.0-29.54	29.5-30.04		
Heathkit I2A	3.8-4.0 L									
Heathkit 22A		7.2-7.3 L								
Heathkit 32A			14.2-14.35 U							
Heathkit SB-301	3.5-4.0	7.0-7.5	14.0-14.5	21.0-21.5	28.0-28.5	28.5-29.0	29.0-29.5	29.5-30.0		
Heathkit SB-401	3.5-4 <i>.</i> 0	7.0-7.5	14.0-14.5	21.0-21.5	28.0-28.5	28.5-29.0	29.0-29.5	29.5-30.0		
Heathkit SB-101	3.5-4.0	7.0-7.3	14.0-14.5	21.0-21.5	28.0-28.5	28.5-29.0	29.0-29.5	29.5-30.0		
National 200	3.5-4.1 L	7.0-7.5 L	13.9-14.5 U	21.0-21.6 U	28.0-28.54	28.5-29.0 U	29.1-29.74			
National NCX5 Mk II	3.5-4.0	7.0-7.3	14,0-14.5	21.0-21.5	28.0-28.54	28.5-29.0	29.0-29.54	29.5-30.0		
SBE SB-34	3.775-4.025	7,05-7.30	14.1-14.35	21.2-21.45						
Swan 350	3.5-4.0 L	7.0-7.5 L	13,85-14,35 U	21.0-21,5 U	28.0-28.5 U	28.5-29.0 U	29.0-29.5 U	29.5-30,0 U		
Swan 40016	3.5-4.05	7.0-7.5 ⁸	13.85-14.355	21.0-21.58	28.0-28.55	28.5-29.05	29.0-29.55	29.5-30.0 ⁵		
WRL Duo-Bander 84	3.8-4.0 L	7.1-7.3 L								

	lst <i>if</i> (MHz)	2nd <i>if</i> (kHz)	Dial Cali- bration	PA Tubes	electable Side Band	cw	ΑМ	VOX	PTT	Offset Tuning	ALC	CW Side- Tone
Babcock B-500-SSB	2.455-2.955	455	100 Hz	4CX250B	yes	yes	6	yes	yes	yes	yes	no
Collins KWM-2	2.955-3.155	455	l kHz	2 6146A	yes	yes	no	yes	yes	no	yes	
Collins 75S-3B	2.955-3.155	455	l kHz		yes	yes	yes			no		yes
Colins 32S-3B	2.955-3.155	455	l kHz	2 6146A	yes	yes	no	yes	yes	no	yes	
Drake T-4 Reciter	5.6 4 5		l kHz	2 6JB6	yes	yes	yes	yes	yes	no	yes	
Drake T-4X Transmitter	5.6 4 5		ı kHz	2 6JB6	yes	yes	yes	yes	yes	no	yes	
Drake TR-4	9,000		l kHz	3 6JB6	yes	yes	yes	yes	yes	no	yes	yes
Drake R-4A Receiver	5.645	50	l kHz		yes	yes	yes		-	no	•	
EICO 753					no	yes	yes	yes	yes	yes	no	
Galaxy V Mk II	9.000		5 kHz	2 6HF5	yes	yes	no	yes	yes	no	yes	по
Hallicrafters HT-46					yes	yes			yes	no	•	no
Hallicrafters SX-146	9.000		5 kHz		yes	yes	yes					
Hallicrafters SR-500					no	yes	no	8	yes	yes		
Hallicrafters SR-540			l kHz	2 6HF5	yes	yes	no	yes	yes	yes		no
Hallicrafters SR-2000			l kHz		yes	yes	no	yes	yes	yes		
Heathkit I2A	2.303-2.3067		l kHz	2 6GE5	yes	no	no	yes	yes	no	yes	no
Heathkit 22A	2.303-2.3067		l kHz	2 6GE5	yes	no	no	yes	yes	no	yes	no
Heathkit 32A	2.303-2.3067		l kHz	2 6GE5	yes	no	no	yes	yes	no	yes	no
Heathkit SB-301	8,395-8,895	3395	l kHz		yes	yes	yes			no		
Heathkit SB-401	8.395-8.895	3395	i kHz	2 6146	yes	yes	no	yes	yes	no	yes	yes
Heathkit SB-101	8.395-8.895	3395	l kHz	2 6146	yes	yes	no	yes	yes	no	yes	yes
National 200	5.200		5 kHz	2 6JB6	no	yes	yes	yes	yes	no	yes	no
National NCX5 Mk II	5.200		5 kHz	2 6JB6	yes	yes	yes	yes	yes	yes	yes.	
SBE SB-34	3.175-3.425	228110	5 kHz	2 6GB5	yes	11	no	12	yes	yes	•	по
Swan 350	5.174			2 6HF5	18	yes	yes	14	yes	no	yes	
Swan 400	5.174			2 6HF5	yes	yes	yes	14	yes	no	yes	
WRL Duo-Bander 84			2 kHz		no	no	по	no	yes	no	пo	no

^{1.} Plus 14.8 to 15.0 MHz for WWV.
2. When used with the R-4A Receiver.
3. When used with the SX-146 receiver.
4. With accessory crystals.

With accessory VFO.
 Optional plate modulator available.
 Selectable bandwidth of 0.4, 1.2, 2.4 or 4.8 kHz.
 With HT 16 VOX accessory, \$37.95.

SSB Power (PEP)	CW Power	AM Power	Output Impedanca	SSB Generation	Carrier Suppression (dB)	Sideband Suppression (dB)	Distortion Products (dB)	Sensitivity	Selectivity (at 6 dB)
600	250		25-100	Mechanical Filter	50	—50	—30	0.5 gV for 10 dB S/N	2,1 kHz
175	160		25-100	Mechanical Filter	 50	—5 0	—30	0.5 gV for I0 dB S/N	2.I kHz
			25-100					0.5 gV for 10 dB S/N	2.1 kHz
175	160		25-100	Mechanical Filter	 50	 50	30		
200	100		50	Crystal Filter					2.4 kHz
200	100		50	Crystal Filter					2.4 kHz
300	260		50	Crystal Filter	50	40		0.5 #V for 10 dB S/N	2.1 kHz
			50		•			0.5 #V for 10 dB S/N	7
200	180	100	40-80	Crystal Filter	—50	40		1.0 gV for 10 dB S/N	2.7 kHz
300	300		25-100	Crystal Filter	45	—55		0.5 aV for 10 dB S/N	2.1 kHz
175	150		50-75	Crystal Filter	—50	50	30	0.5 \$2 1.01 10 0.5 0,11	
			50-75			•	•		2.1 kHz
500				Crystal Filter	50	 50			2.1 8.12
400	300			Crystal Filter	50	—50		1.0 µV for 20 dB S/N	
2000				Crystal Filter		•			
200		50	50	Crystal Filter	45	—45		1.0 µV for 15 dB S/N	2.7 kHz
200		50	50	Crystal Filter	45	—45		1.0 µV for 15 dB S/N	2.7 kHz
200		50	50	Crystal Filter	45	—45		1.0 µV for 15 dB S/N	2.7 kHz
			50	Crystal Filter				0.25 gV for 10 dB S/N	•
180	170		50-75	Crystal Filter	 55	—5 5	30	p	
180	170		50-75	Crystal Filter	50	55	30	1.0 µV for 15 dB S/N	2.I kHz
200	200	100	40-60	Crystal Filter	50	-40	-30	0.5 µV for 10 dB S/N	2.8 kHz
200	200	100	40-60	Crystal Filter	—50	—5 0	30	0.5 μV for 10 dB S/N	2.8 kHz
135			40-100	Mechanical Filter	50	-40	-25	1.0 µV for 10 dB S/N	2.1 kHz
400	320	125	50	Crystal Filter	50	-40			
400	320	125	50	Crystal Filter	50	-40			
300			25-100	Crystal Filter	50	—45		1.0 µV for 10 dB S/N	2.7 kHz
Cauchal		40		D.C	Remote		c	ita Waight	

Crystal Calibrator	AC Supply	Price	DC Supply	Price	Remote VFO	Price	н	Size W	D	Weight (Ib)	Price
Built in	Built in		Built in				71/2	17	12	24	\$1195.00
Built in	516F-2	\$153	MP-I	\$198	312B-5	\$350	73/4	143/4	14	19	\$1150.00
Built in	Built in	•					73/4	143/4	14	20	\$ 658.00
	516F-2	\$153					73/4	143/4	14	16	\$ 795.00
	AC-4	\$100	DC-3	\$150	RV-4	\$100	51/2	103/4	113/8	14	\$ 299.95
	AC-4	\$100	DC-3	\$150	RV-4	\$100	51/2	103/4	11%	14	\$ 399.95
Built in	AC-4	\$100	DC-3	\$150	RV-4	\$100	51/2	10¾	143/8	16	\$ 599.95
Built in	Built in	·		•		•	51/2	10¾	113%	16	\$ 399.95
	751	\$ 80 k	752	\$ 80 k			5/8	141/4	111/4	25	\$ 189.95 k
		\$110 w		\$110 w							\$ 299.95 w
\$19.95	AC 35	\$ 80	G35A	\$100		\$ 70	6	101/4	111/4	13	\$ 420.00
	Built in			•					• •		\$ 349.95
\$19.95	Built in										\$ 269.95
\$19.95	P500AC	\$120	P500DC	\$150							\$ 395.00
	P500AC	\$120	P500DC	\$150			61/2	15	13	20	
	P2000AC	\$395					71/2	101/2	15		\$ 995.00
\$ 8.95	HP23	\$ 40	HPI3	\$ 60			61/4	121/4	10	12	\$ 99.95
\$ 8.95	HP23	\$ 40	HPI3	\$ 60			61/4	121/4	10	12	\$ 104.95
\$ 8.95	HP23	\$ 40	HPI3	\$ 60			61/4	121/4	10	12	\$ 104.95
Built in	Built in						65/8	147/8	133/8	17	\$ 260.00
	Built in						65/8	147/8	13%	27	\$ 285.00
Built in	HP23	\$ 40	HPI3	\$ 60			6%	147/8	13%	23	\$ 360.00
\$26.60	AC200	\$ 75					6,7	13%	11	15	\$ 359.00
Built in	NCXA	\$110			VX501	\$250	614	13%	11%	26	\$ 549.00
\$24.50	Built in		Built in				5	111/4	10	19	\$ 419.00
\$19.50	AC-PS	\$ 95	15		410	\$ 75	51/2	13	- 11	18	\$ 420.00
\$19.50	AC-PS	\$ 95	15		410	\$ 75	51/2	13	11	18	\$ 420.00
Not Available	AC-384	\$ 80	DC-384	\$100			5	111/4	10	16	\$ 159.95

Selectable bandwidth of 0.4, 2.1 or 3.75 kHz.
 Third if at 455 kHz.
 With optional SB-2 CW Codapter, \$42.50.
 With optional VOX adapter, \$37.95.
 With optional SSB-2 selectable sideband kit, \$18.00.

^{14.} With optional VX-I VOX unit, \$35.00.
15. Various DC supplies available; check with your distributor for recommendations for your station.
16. Swan 500 announced too late to be included.

HF SSB Linear Amplifiers

Model	Bands	SSB Power (PEP)	AM Power (Watts)	CW Power (Watts)	Drive Power (Watts)	Input Imped- ance	Output Imped- ance	PA Tubes	Class	Distor- tion Products
BTI LK-2000	80-10	2000	1000	1000	50-200	50	25-100	1 3-1000Z	В	−30 dB
Collins 30L-1	80-10	1000		1000	70-100	50	25-100	4 811A	В	-30 dB
Collins 30S-1	80-10	2000		1000	60-100	50	25-100	1.4CX1000A		-35 dB
Drake L-4	80-10	2000	1000	1000	100	50	25-100	2 8163	В	
Galaxy 2000	80-10	2000		1000	90-200	50	25-100	10 6HF5	A8 ₁	-30 dB
Gonset GSB-201	80-10	2000	400	1000	65-150	50	50	4 811A	В	
Hammarlund HXL-I	80-10	1500	250	1000	60-70	50	40-80	2 572B	В	
Henry 2K-2	80-10	2000	1000	1000	80-150	52	25-100	2 3-400Z	В	-35 dB
Henry 2KD-2	80-10	2000	1000	1000	80-150	52	25-100	2 3-400Z	В	-35 dB
Henry 4K	80-10	4000	2000	2000	150	52	25-100	1 5CX1500A		-35 dB
Heath SB-200	80-10	1200		1000	100	52	50-75	2 5728	В	-30 dB
Heath KW Kompact	80-10	1000			100	52	25-50	2 572B	В	-30 dB
Hunter Bandit 2000B	80-10	2000	600	700	100	52	50-72	4 572B	В	
National 2000	80-10	2000	1000	1000	20-200	50	40-60	2 8 1 2 2	AB ₂	30 dB
SBE SB2-LA	80-15	1000	300	400	65	75	25-100	6 6JE6	AB ₁	-25 dB
Swan Mark I	80-10	2000		1000	100	50	25-100	2 3-400Z	В	

Output Indi- cator	SWR Meter	Plate Voltage Meter	ALC	Internal Antenna Relay	AC Input (volts)	AC power (Watts)	н	w	D	Weight (Ib)	Price
Yes	No	Yes	Yes	Yes	115 or 230	2300	30	161/4	16	1151	\$ 795.00
Yes	No	Yes	Yes	Yes	115 or 230	1200	73/4	143/4	133/4	39	\$ 520.00
Yes	No	Yes	Yes	Yes	115 or 230	2000	305/6	17	1834	160	\$1795.00
Yes	No	Yes	Yes	Yes	115 or 230	3450	77/8	14	15	75²	\$ 695.00
Yes	No	Yes	Yes	Yes .	115 or 230		6	111/4	101/4	448	\$ 450.00
Yes	No	No	No	Yes	115		81/2	12%	17	82	\$ 345.00
Yes	No	Yes	No	Yes	115 or 230		91/8	171/2	15	66	\$ 395.00
Yes	Yes	Yes	No4	Yes	115 or 230	3450	291/2	143/4	17	135	\$ 675.00
Yes	Yes	Yes	Not	Yes	115 or 230	3450	7	143/4	17	85ħ	\$ 675.00
Yes	Yes	Yes	Not	Yes	115 or 230	4910	291/2	143/4	171/2		\$ 980.00
Yes	Yes	Yes	Yes	Yes	115 or 230	1920	65/8	14%	133/8	35	\$ 200.00
Yes	Yes	No	Yes	Yes	115, 230 or ^e 12.6 Vdc	1920	378	1216	10	7	\$ 99.95
Yes	No	Yes	No	Yes	115 or 230		73/4	143/4	131/4	45	\$ 575.007
Yes	No	Yes	Yes	Yes	115 or 230	3450	75/8	161/2	123/4	62	\$ 685.00
Yes	No	No	No	Yes	1158	1640	5¾	12	121/2	40	\$ 259.00
Yes	No	Yes		Yes	115 or 230		81/2	151/2	19		\$ 543.00

- 1. Console model; also available in desk top rf unit with separate power supply.
 2. Dimensions of rf unit; power supply is 71/8 x 63/4 x 11 inches.
 3. Dimensions of rf unit; power supply is 71/4 x 9½ x 7½ inches.
 4. Manufacturer states that commonly available exciters will not drive unit beyond linearity.
 5. Dimensions of rf unit; power supply is 6 x 14½ x 17 inches.
 6. With external power supplies. For AC, the Heath HP-24, \$49.95; for DC, the Heath HP-14, \$89.95.
 7. Available in kit form for \$249.50.
 8. SBE's SB3-DCP mobile inverter available for 12.6 Vdc.



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SYDMUR SOLID STATE "CD" IGNITION SYSTEM! High Quality Components used throughout. Fiberglass Printed Circuit Board. Unitized Construction. Simplified Kit Assembly. Reduces ignition interference.

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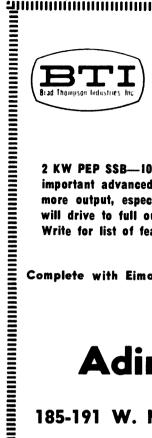
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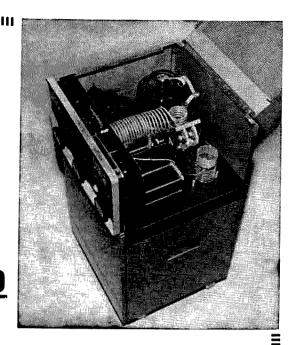
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BRAD THOMPSON INDUSTRIES LINEAR AMPLIFIER

2 KW PEP SSB—1000 DC Watts CW-AM-RTTY. 21 important advanced features. New HD tank gives more output, especially on 10 meters. 55 Watts will drive to full output. 220/115 VAC operation. Write for list of features.

Complete with Eimac 3-1000Z \$79500



Adirondack Radio Supply

GLEN FADDEN, W1ZQA/2

185-191 W. Main St., Amsterdam, N.Y. 12010, 518-842-8350

Improved Electrical Connector for the Ham-M Rotator

After a Ham-M antenna rotator has been in use for several years, particularly in wet climates, the terminal strip at the bottom often becomes severely corroded and should be replaced. Rather than use another terminal strip which will have to be replaced in several years, a better approach is to install a waterproof connector. In addition to being waterproof and long lived, these connectors provide an extremely convenient method of connecting and disconnecting the rotator control cable when working on your tower. If you have ever installed a rotator, you know that connecting those eight control wires while you are seventy feet in the air is no mean task.

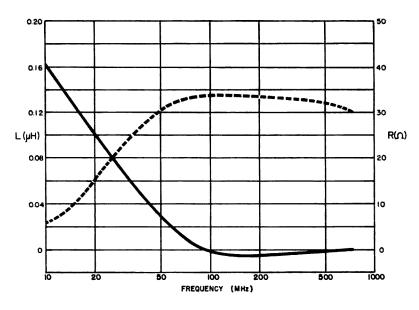
Two inexpensive connectors which are suitable for this job are the Amphenol MS 3106B-18-8S (cable receptacle) and MS 3102A-18-8P (chassis mounted plug). These connectors are available from Allied Radio Corporation* for \$2.40 and \$1.16 respectively. When ordering, specify stock number 47 D 7000C.

To install the chassis plug on the rotator, cut a small piece of aluminum the same size

as the old terminal strip and cut a hole in its center to mount the new chassis plug. Remove the old terminal strip from the rotator and carefully label each of the control wires (1, 2, 3, etc) with a piece of masking tape. Place the new connector strip in position and install the control the control wires on the new connector. The pins on the MS connectors are labeled with the letters A through H, so it is probably most covenient to connect wire number 1 to A. number 2 to B, etc. After the control wires are connected, install the connector mounting plate in the bottom of the rotator and attach it with screws through the original screw holes in the rotator housing. At this point it is a good idea to put some household caulking compound around the edge of the connector mounting plate to prevent moisture from getting into the rotator.

This scheme has been used several times and has proven to be particularly advantageous in wet climates or where ice is likely to collect on the rotator.

*Allied Radio Corporation, 100 N. Western Avenue, Chicago, Illinois 60680.



Joe Williams W6SFM 4150 Beck Avenue North Hollywood, Calif. Photo courtesy Ami-Tron

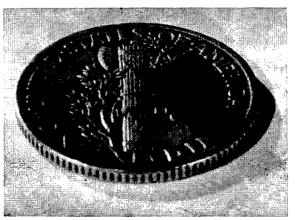
Ferromagnetic Beads

They say that good things come in small packages. And in case of ferrite beads, it's true. The Space Age and all that it implies has seen a reduction in the physical sizes of our components and some of our finished ham gear. Smallness for smallness' sake probably proves little, but when an inductor the size of a match head will perform useful tricks for us—that's handy news.

The beads have been around for a while but they haven't been readily available in amateur quantities until quite recently. The literature, similarly, has been pretty quiet on the subject of specific ham applications for this tiny component. It is most likely, then, that amateurs will expand the usefulness of these unique radioferric devices just as soon as they enjoy a wider circulation.

By simply slipping a bead over a 18 20 or 22 wire, an inductor is created. Going back to the basics for a second, we can recall that an inductor is an electromagnetic device possessing "self inductance" which is the quality of opposing changes in the current flowing through the circuit. This opposing action impedes the flow of the higher frequencies and can be assigned an ohmic value from the equation: $X_L = 2\pi fL$. When ferromagnetic matter is used as a core within or is posed near a coil, the reactive value of the inductor goes up as a nonlinear function of the permeability of the ferric material. Without plowing through the formulae, we can say that the Permeability Factor (μ) expresses the ratio of inductive magnification that a ferrous core will add to a plain wire inductor. For example, a toroid with a powdered iron core having a permeability factor of 10 will exhibit ten times the inductance as would the same circular coil with an air core. Meanwhile, back at the bead, we have a short length of wire having a certain small finite inductive value of its own. The addition of the bead, with a permeability factor of 900, elevates the inductance so that we have a localized high impedance point. The spectral usefulness of an Ami-Tron bead with mix "3B" is generally from 300 kHz through 300 MHz. As the frequency goes up, there is an attendant increase in the isolating ability of the bead.

The shielding action of a bead is due to the bead's offering a lossy medium to unwanted radiomagnetic influences within a circuit structure. Thus, stringing a wire with beads is a neat way to dampen rf feedback



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paths that often result in either obvious or subtle parasitic effects. As we have all had occasion to witness, the feedback pick up is greater in high impedance circuitry. Grids and gates are sitting ducks for strong rf fields. In practical terms, the thing to do is to slip a bead or three over the wire connecting to the base, grid or gate. In printed circuit work, the beads should be threaded over the element lead between the semiconductor case and the circuit board. It is not necessary that the beads be grounded.

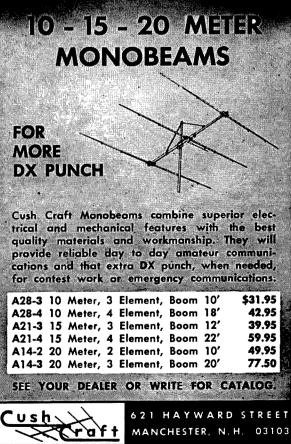
It is unlikely that ferrite beads will completely replace the ubiquitous 2½ mH rf choke, but they do offer some attractive decoupling qualities. When a bead is placed on the conductor leading to or from an active rf circuit, we have, in effect, a miniature rf choke. Its inductance may be in the order of a few nanohenries, but at VHF this can be very useful; and the simultaneous bulk shielding action is pure serendipity.

In addition to the suggestions contained in the Ami-Tron spec sheet, it is to be expected that ferromagnetic beads will find themselves being used by hams in ways that are limited only by the imaginations of the users. Consider the case of the hard to cure key click, or TVI, that develops in a sharply tuned Class C amplifier that is trying or succeeding in its efforts to go into business for itself as an oscillator. Unneutralized tetrodes such as the old work horses 813 and 807 are famous for this stunt. The spectral garbage that results usually fails to respond to the more general handbook nostrums and an operator can spend whole week ends decoupling nearby innocent circuitry. It sounds a little David And Goliath, but one bead on the right tetrode G1 could do the trick. It is just a question of time until some VHF man will make a space saving Pi-Network consisting of two capacitors and one bead. I'm anxous to try some beads between the suppressor grid and ground on a couple of sluggish pentode if stages. The mild regeneration created by this amount of decoupling should narrow the pass band and bring up the gain. But first, there is the matter of weaving a few beads into the crystal mike circuit to get rid of that rf feedback for good, this time.

. . . W6SFM

A package of 12 ferromagnetic beads is available for \$2 from Ami-Tron Associates, 12033 Otsego St., North Hollywood, California.





A Canadian Assault on FP8

Geoff, VE1UC, walked up to the ticket counter at Air St. Pierre and asked for three tickets to the island. The young lady at the counter gave us our tickets and boarding passes and sent us to check our baggage. Arriving at the baggage counter, the same young lady checked our bags, and at yet another counter she collected our overweight payments. As we climbed on the venerable DC-3 she accepted our boarding passes. With a polite inquiry as to whether or not she would spin the props as well ("oh no, M'sieur, they are electric-starting!"), we settled in our seats, buckled on our French accents, and were off.

This episode, on August 1, 1966 marked the end of four months' preparation for the first VE1 expedition to FP8 land.

Don, VEIAMC, and myself, VEIADH, had driven up to Sydney, met Geoff, and now the three of us were finally in the air—hoping the fog had lifted over St. Pierre, and wondering if the book the pilot was reading was a DC-3 operation manual. Snuggled in the cargo hold was an SX111, FL100B, and Gonset 6-meter rig—all packed "lak eggs, yes?" against the whims of French cargo-handlers.

Some two hours later we arrived over the island. For miles around visibility was unlimited—no difficulty at all in seeing the vast fog bank sitting off the coast of St. Pierre. Our hearts sank lower and lower. Small wonder, our stalwart birdman was coming in for a landing—the runway was ahead—a hole in the fog—and we're down! "Say, Don, how did we ever miss those fishing shacks? Oh, well.

The runway on St. Pierre is dirt, and pretty short—so much so that when taking off the pilot makes a sharp left bank immediately upon liftoff—to avoid those fish-

ing shacks! At one end of the runway is the smashed remains of a DC-3, which boobed up a landing—and at the other end, a similar corpse marks a poor takeoff—"Ah, but m'sieur, those planes do not belong to Air St. Pierre—our predecessors, you know". Our faith restored in our pilot (we had to fly back, y' know), we set about rescuing our bags. The cargo-handlers looked very competent and we had utmost faith in their ability—we only helped them unload our gear for the exercise!

Having cleared customs, and paid our \$1 landing fee, we discussed the best way to get over to our hotel. "How's your French?" seemed to dominate the conversation for a spell. Finally I took the bull by the horns, walked up to the nearest gendarme and said "Gus Roblot?" (FP8AP was our contact on St. Pierre). "Aha", says the gendarme, breaking into a smile, "les radio-amateurs!" That's the magic word on the island-we weren't tourists, but radio amateurs! A world of difference! Off to the telephone-Gus is summoned, and soon arrives in a venerable stationwagon. Gus-a Frenchman's Frenchman-and one darn nice guy. He was indispensable to us, and anybody planning a trip to FP8 should write him. Life is so much simpler with an interpreter.

We were soon at the hotel, our bags deposited, and assured that our license would be forthcoming tomorrow. We set up our station, strung up our antennas, and went out to see the town.

St. Pierre looks very similar to any fishing village found on the Nova Scotian coast, and I commented to Don as we walked along that it didn't seem to be "a tiny Paris"—but our opinions changed very quickly. The main part of the town looks over a large square situated on the waterfront. Tourists

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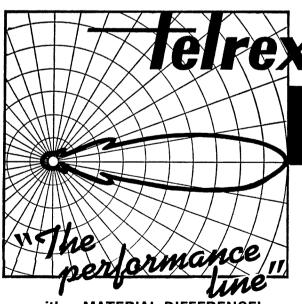
abound: fishermen are tending their nets, grandmas are sitting in the sun, mothers walk their babies—and on a park bench in the middle of the square, at 2 P.M. in the afternoon, this French couple is making out like nothing you ever saw in any French movie! "Sydney was never like this!" exclaimed Geoff. As we headed for the nearest outdoor cafe and our first taste of FP8 hospitality, we were prone to agree.

A work about this hospitality—it's terrific. The people are friendly and go out of their way to assist "les radio-amateurs" in every way. We had two rooms side by side, with a total of three beds, and this, with three meals a day cost each of us \$6.80 per day at the New Royale Hotel. Madame Miller was an angel, and couldn't have been nicer, even at 3 A.M. one morning when Geoff and I rolled in showing the effects of the local lightlife. The food was delicious and the wine was on the table for every meal (even breakfast!).

The following day we were picked up by Gus and went off to collect our license. We soon returned—proudly bearing FP8DA, and away we went. Lots were drawn for first QSO, and VE1AMC fired up on 20 CW and shortly raised VE3GEG in Georgetown; next was WB2PXU, WB2JJF, WB2GKZ, and from then on we were working one every three minutes. With half the bank calling us, we took shifts operating and

logging, and soon became quite adept at switching ops in the middle of a QSO.

Don had set his hopes on a 6 meter opening, and we had a dipole on the hotel roof. At 2030 GMT I tuned in on 6 (we were monitoring during the entire week and heard CO-the W1V1A/1 calling band opened! I grabbed the mike and called: "W1V1A/1, here is the French island of St. Pierre, FP8DA, calling on 6"-"what did he say that call was? F-something? Give me that again, OM" (a tremor of excitement in his voice), "WIVIA/1, here is FP8DA, FP8DA, on St. Pierre Island, how copy?" "I'll be FP8DA on some island-this is W1VIA/1 . . . where are you guys? . . let me write this down . . ." Fellas, it was beautiful. You forgot our call, you forgot your calls, you signed after our transmissions without giving us RST and QTH-I never heard such excitement. The whole opening was calling FP8DA. and that hour's opening made the whole trip. We worked 50-odd QSO's in 9 states, and never had so much fun in our lives. I'll never forget sitting on the bed about half-way through the opening. At one end of the room sits Don, peeling off QSO after QSO, on 6, and muttering . . . "Spread out fellas, don't all call at once . . . where did they all come from?", while at the other and Geoff is working one a minute on 20 CW and singing . . "They're coming



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to take me away, ha ha, ho ho, hee hee . . . "

About 9 P.M. we packed it in, and went out to explore the night life. We soon discovered that drinks were \$.40 a piece. (\$.50 if you asked in English). The drinks were all three fingers apiece, and if you wink at the bartender and say "Un peu aussi, s'il vous plait" he splashes in another finger or two. Canadian or American currency is accepted, and Geoff and I managed to get utterly stiff on \$2 every night we were there. Don, who doesn't indulge, kept the fires burning on 20 at night, and tucked us into bed when we managed to find our way home.

A few incidents which took place during our stay:

I was dancing half one evening with a pretty young miss, struggling the while to make a favorable impression while cursing my despicable French: finally, after a particularly frustrating session while I tried to explain how fast my green Triumph would go, she ups and says "You know, your accent really is terrible!" Turns out she is a University of Toronto student studying French on the island!

One evening Geoff and I are walking along a street in town when a very distraught woman, very obviously an American tourist, runs up waving her arms and wailing that she was lost-couldn't speak French-and ". . could you nice boys tell me how to get back to the boat?" Geoff, who was wearing his beret, puts on his bon vivant look and says "Pardon, madam, je ne parle pas l'Anglais . . . parley-vous français?" tourist gave him a dirty look and walked off muttering something about "another one". Another time we were on a bus waiting to go to a roadhouse outside of town, while some chaps from an American sailboat debated if they should go. Our bon vivant, avec beret, leans out the window and growls "Messieurs, le Savoy, tres bien. Venez avec moil". The lads trooped aboard, and ended up as looped as any. I think it was Geoff kissing his fingers and winking that got

Wednesday night Geoff and I arrived home in the wee sma', somewhat cheerful—to find Don and some stranger ensconced in the shack in front of a SB100 hooked up to our antenna, and killing them on 20 SSB. Turns out that John and Shorty, VE3EWM and VE7AZ had arrived that

evening for a few days. Anybody who worked FP8DA that night after we arrived may have wondered at the strange noises in the background—it was Geoff and myself being suppressed by Don so John could work new countries for FP8DA. The next day the boys received FP8DB, and provided us with a new country (St. Pierre, what else?)

The rigs worked FB, except for a melted pi coil on the second day. We left the transmitter out of the case after that and spent the evenings watching a room across the road increase in light intensity by a factor of 3 each time we pressed the key. The T.V. watcher never did complain (wonderful people!), but expressed his ire by heaving the occasional rock at the hotel wall. We could gauge the programs he enjoyed most by the "thump frequency".

Toward the end of the week VE1TG, George, and a chum wandered in, and we also had a visit from FP8CY. We all sat down to supper together one night, and by the time the second bottle of wine arrived we were into a real hamfest.

The Sunday following, we packed up our gear, rescued our antenna tuner from FP8DB, and folded our tents. With a last "au revoir" from Madame Miller, our fingers crossed against the fog moving down off the mountain, and a prayer that the pilot wasn't at that last party, we boarded the DC-3 and silently stole away.

Statistics? We had 700 QSO's, worked 34 states (9 on 6 meters) and 33 countries. The trip cost each of use \$150 (including plane fare) for the week. The weather was warm most of the time, the wine was sweet and so were the gals. The thing that impressed us the most was the proficiency of the French drivers in survival; traffic control on the island consists of beeping as you enter each intersection, the theory being that if you hear another beep, you've had an accident.

Anybody planning a trip is urged to write Yvon Segineau at the Bureau de Radio Communications on Saint Pierre well in advance for licensing info. They are stiffening their procedures, and licenses will not be issued as casually as in times past.

We all enjoyed the trip tremendously, and unanimously invite you all to join us when we hit the beach again next summer. Return, you ask? Mais oui, messieurs! Au certainement!

. VE1ADH

"Get-Acquainted-with-Sideband" offer

During the course of any given week, I meet several hundred hams and as a result of these experiences for the past several years, I feel I can interpret what the average ham is looking for. Our business is, therefore, geared to supply the hams the items which they want and which they can afford to buy.

In consequence of the approaching 11-year sunspot peak, 5-band transceivers are literally selling like hot cakes, and hams who heretofore have been happy with a 3-band model have been trading them in at a relatively high rate. We think this is sound business but now we have the problem of marketing these excellently designed 3-band sideband transceivers. As an example, as I write this ad, we have in stock 36 National NCX-3's. This very popular device is rated 200 watts input for sideband, 200 watts on CW, and 100 watts on AM. It will provide 120 watts RMS out. It will match any coax fed antenna between 40 and 60 ohms impedance. It covers a frequency range of between 3480 and 4020 KC on 80: between 6980 and 7310 KC on 40; and between 13880 and 14420 KC on 20. The band width is 21/2 KC. Sideband generation is by means of a 5200 KC crystal filter. The overall drift is negligible—not exceeding 400 cycles after 15 minutes warm up. The unwanted products are down 40 db; the carrier down better than 50 db. The NCX-3 uses 18 tubes and 16 diodes. Mechanically, it is 61/16" high x 13%" wide x 11%" deep and weighs approximately 15 lbs. net.

We offer re-manufactured NCX-3's. (This is our term for a set that has been exhaustively checked out and which is impeccably clean), together with a choice of power supply combinations at what I honestly believe to be the lowest price in the nation. Listen to this. We will provide the NCX-3 together with a kit of power supply components for only \$250 f.o.b. Harvard. This breaks down to be better than \$82 per band, a lower price than any comparable offering made even for a kit on a tri-

band set.

Our power supply is a universal sideband transceiver power supply which furnishes between 800 and 1,000 volts for the final, between 250 and 320 volts for the exciter stages and the receiver, 12.6 volts of AC at 61/2 amps, 14 volts of DC for relays, and bias of up to minus 100 volts at 100 mils. We furnish the chassis, the bottom plate, and even a matching speaker and proper plug for the NCX-3. We furnish all of the components except the hardware with which you can mount the pieces. We tell how to build this supply. This supply weighs better than 40 lbs. when finished. It is a rugged unit. The transformers weigh in excess of 17 lbs. There are heavy, rugged parts employed in every circuit. We use, for example, four 400 mfd capacitors. As another illustration, we furnish twelve 800 volt diodes. You can build this supply in one evening and be on the air the second evening.

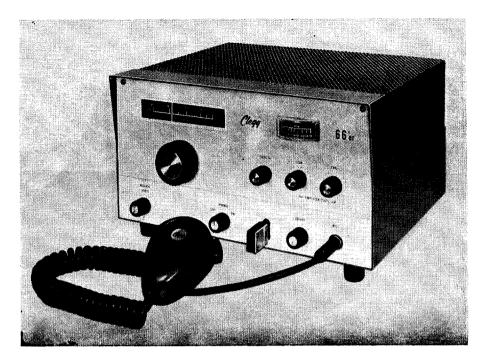
If you are one of the boys who as yet has not tried sideband—and you are now looking for an excuse to break in at an inexpensive price, here is your deal. Best of all, the power supply we furnish will allow you to subsequently operate any of the standard transceivers made today including Swan, Drake, Collins, Hallicrafters, and National. There would be no need, for example, to buy a second power supply in the future. We guarantee what we offer and this is, practically speaking, one of the very best buys that we have ever offered to the American ham. Trades are acceptednaturally; time payments are available for those who have credit. This offer is limited, however, to the extent that our stock shall last. Remember, you get an instruction book on the transceiver and on building the power supply and that you can operate 3 bands-CW, AM, or sideband—for only \$250. We offer the same deal with our power supply wired by our own boys for only \$50 more. In other words, \$300 will buy a package that you can plug in when you get it.

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The Clegg 66'er Six Meter Transceiver

Interested in 6 meters? The Clegg 66'er from Squires-Sanders does an outstanding job and is an ideal rig for the ham who operates on our 50-MHz band. This transceiver contains a stable and sensitive receiver and a 22-watt transmitter in one compact package. It was designed specifically for the six meter band and will cover the amateur frequencies as well as those for MARS, CAP and Civil Defense. In addition, both the 117 Vac and 13 Vdc power supplies are included in the package.

The dual conversion superhet receiver is extremely sensitive and less than $0.35~\mu V$ signal will provide a signal plus noise to noise ratio of 10 dB. The basic frequency range is 49.9 to 52.1 MHz, but for special applications, an expanded tuning range is available on special order. The two *if* frequencies of 10.7 MHz and 456 kHz provide 8 kHz selectivity and result in rejection of spurious responses by more than 60 dB.

The receiver is relatively straightforward with a 6EH7 in the front end, followed by a 6DJ8 converter to the 10.7 MHz if and a 6BA6 if amplifier. The injection frequency for the first conversion is provided by a 6KE8 VFO/buffer; this combination is quite

90

satisfactory and results in less than 3 kHz drift per hour after a 20 minute warmup. The 10.7 MHz *if* signal is converted to 456 kHz in a crystal controlled 6BE6 converter and further amplified in another 6BA6 stage, followed by a 12AL5 detector, a 6AN8 audio amplifier and a 6AQ5 audio power stage.

The AGC voltage generated in the 12AL5 detector stage is applied directly to the two *if* amplifiers and the 2nd mixer and through a Zener diode to the rf amplifier; in this way no AGC is applied to the input stage until comparatively large signals exist. The other half of the 12AL5 is connected as a series gate impulse limiter; it is very effective in cutting down ignition and other types of impulse noise.

A semiconductor diode is connected as a series squelch diode between the output of the detector and the input to the first audio stage. Whenever the cathode of this diode is more positive than the anode, the audio sections of the receiver are effectively disconnected from the front end of the receiver. Since the anode of the squelch diode is connected to the screen voltage of the

6BA6 456 kHz if amplifier through a decoupling network, the voltage on the anode varies automatically as the screen voltage follows the AGC level. The cathode of the squelch diode is connected to a voltage divider across the B+ supply; the cathode voltage (and therefore the squelch level) is set to the desired threshold with a potentiometer in this divider.

No tricks in the transmitter section of the Clegg 66'er either; time proven circuitry starting off with the triode section of a 6KE8 in a Colpitts type crystal oscillator. The 25 to 26 MHz harmonics of this oscillator are coupled to the pentode section of the 6KE8 through a bandpass coupler; this pentode is operated as a frequency doubler to 50 to 52 MHz and is bandpass coupled to the 12BY7 driver stage. Considerable reduction in undesired outputs is obtained by using bandpass coupling and straight through operation of the six meter driver

In the final rf power amplifier, a 2E26 provides 13 watts output with 22 watts input, an efficiency of 59%. This final stage is plate and screen modulated by a pair of 6AQ5's. By carefully choosing the design constants in the modulator circuit, high frequency splatter components are completely filtered out. In addition, the operating level of the 6AQ5's was chosen so that grid clipping and plate bottoming occur at approximately 10 watts audio. Therefore, overmodulation is prevented while providing effective speech clipping at the 90 percent

The triode and pentode sections of a 6AN8 are used respectively as a microphone amplifier and audio driver. The pentode actually does double duty in the 66'er; in the receive mode it operates as an audio amplifier.

One of the big advantages of the Clegg 66'er is the built in power supply which will operate from either 117 Vac or 13.8 Vdc by simply plugging in the correct plug. Furthermore, either positive or negative ground de systems may be accommodated by a simple rewiring job. The versatility of this power supply is a direct result of the two winding transformer which it uses; in the ac mode, the 117 Vac is connected to one of the two primary windings on the transformer. In the dc mode, the 13.8 Vdc drives a two transistor inverter which is connected to the other primary winding.

The Clegg 66'er transceiver is one of the most versatile six meter transceivers that this reviewer has seen. It fits right in with fixed station operation, mobile operation or even for mountain topping during VHF contests. And-if you're not satisfied with 22 watts input, you can always plug it into the Appollo linear. Zingo-675 watts de! ... W1DTY

Receiver

Frequency coverage: 49.9 to 52.1 MHz.

Sensitivity:

Less than 0.35 µV for 10 dB signal plus noise to noise ratio. Suppressed more than 60

Spurious responses:

dB. More than 10 db compression for 40 db signal in-

crease. Selectivity:

Tube lineup:

8 kHz. 6EH7 rf amplifier, 6DJ8 1st mixer, 6KE8 oscilla-tor/buffer, two 6BA6 if two 6BA6 if amplifiers, 12AL5 detector/ANF, 6AN8 audio am-12AL5 plifier, 6AQ5 audio output, and three semiconductors. Dual conversion superhet with it's at 10.7 MHz and

456 kHz; less than 3 kHz

drift per hour after warmup; ANL, adjustable squelch; greater than 2 watts oudio output.

Transmitter

Features:

Frequency coverage: Crystals required:

50 to 52 Mhz with external crystals or VFO. 8.333-8.667 MHz, 12.5-13.0 MHz, or 25.0-26.0 Mhz in HC-6/U holders.

Power input: Power output: Output

22 watts. 13 watts. 52 ohms.

impedance: Harmonic and spurious outputs:

Harmonics suppressed more than 50 db; spurious outputs other than har-monics suppressed by

Tube lineup:

more than 66 dB. 6KE8 crystal oscillator/ frequency multiplier, 12BY7 driver, 6AN8 speech amplifier, two 6AQ5 mod-ulators, 2E26 rf power amplifier.

Features:

100% modulation with more than 10 dB speech clipping with a -56 dB microphone; audio re-sponse ±3 dB from 300 to 3000 Hz: exciter stages broadband and multituned for rapid QSY and low spurious and harmonic outputs.

supplies:

117 Vac, 50/60 Hz and 13.8 Vdc supplies included. 50 W on receive; 85 watts

Power requirements: on transmitter. ze and 12" x 12" x Size and

6 1/2 ". x 12" pounds.

weight:

Power

\$249.95.

19

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CLEGG "66'er



transceiver complete flexibility—built-in dual power supply for 115 VAC or 12 VDC, compact size make it ideal for mobile, fixed or field use. Loud and clear reception—highly sensitive and selective dual conversion receiver offers great freedom from birdies, tweets and spurious signals. Front end design provides superb signal capture, freedom from cross modulation and overload. High Talk Power Modulation is achieved by an effective 22 watt input transmitter, with speech clipping. For a clean 70-75 watts output, combine the "66'er" with the powerful Clegg Apollo Linear Amplifier. Built-in S-meter serves as tune-up meter for transmitter. The spectacular new 66'er is great for hams, CD, MARS and CAP operators. See Clegg and Squires-Sanders communications products at your dealer. Write for literature today to:

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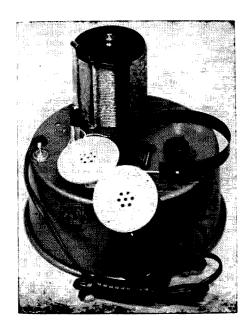
Morse Code a Stumbling Block?

If you were once a Boy or Girl Scout and had to learn morse, do you remember how you did it: A is dot-dash; B is dash-dot-dot-dot, etc-phonetically? Or even if you used a key and a buzzer it was by memory of the dits and dahs, rather than by the group sounds of the characters as in the case of speaking words.

Trying to remember the dits and dahs as simply dits and dahs has a natural limitation at the point where you require too long an interval to say to yourself: that was F or Q, etc., because the first or second dit or dah of the next leter has been sent and you have missed it while trying to identify the preceeding one. If you had to do this when listening to others talking—hesitate after each word to figure out what the word meant, what a dull conversation would result. Think how long it would take to get a reaction to a joke!

For people who have learned the individual dits and dahs it takes a long time to break through into the group-character areashort words, then longer words and real fun with code.

There is at least one method available by which you can speed up your code learning, a method which has proven itself over the years to be superior to others. This is the "Teleplex" method. Teleplex is a code sending machine using metal rolls instead of tape, so they never wear out, which is fully adjustable in speed, emitting a 750-hertz tone which seems to be the best tone at





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which the ear begins to get the dit-dah sounds as groups and words. Loud, high pitched tones apparently create unrecognized echoes which interfere with the recognition of group sounds, slowing down the learning process.

The Teleplex theory emphasizes first the 750-hertz, which cannot be varied, and second that the student should know in advance (during the early phase of the course) what words are coming, so that instead of trying to pick out the individual letters he will become conscious of the letters as group sounds in their naturally rythmic relationship, as is the case with the words you speak. Also, Teleplex permits a gradual almost imperceptable, change in speed, so that rather than trying to copy 5 wpm faster than you can now copy, you can increase the speed by fractional wpm and not be under such strain. In this way you can continue to recognize the word groups, rather than jumping into a speed where the groups are indistinguishable.

Teleplex can be purchased or rented. Write them at 739 Kazmir Court, Modesto, California.

. . . K1RA

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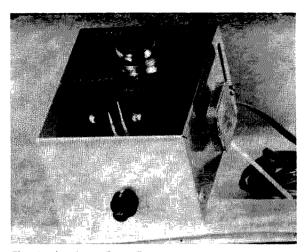
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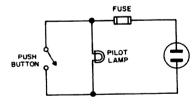
The Little Gem Fuse Tester



The Little Gem Fuse Tester.

Here's an oldie that we haven't seen around for ten or fifteen years. There are several versions of this little first-day-of-April gadget. Ours calls for a neat little Minibox, a nice big bull's eye pilot light (110 volt variety), a fuse in its holder, a push button, a spare fuse container with spare fuses, and a cord with plug. See the photo.

On ours we put the title "Little Gem Fuse Tester" on a plastic label at the top. In the center we put "If lamp lights, fuse is good". There is no label on the push button. Everybody has an uncontrollable urge to push a button. If you push the button, of course the fuse is blown and the light goes out.



Schematic of the Little Gem Fuse Tester.

There are several approaches to the use of this "Little Gem". One way is to simply lay it on an associate's desk or work table. He will probably come in pick it up, plug it in, and try it out. As soon as he realizes that he has been had he will put it on the next person's desk. . . The spare fuse container may have to be refilled a time or two during the day. One variation is to leave out the fuse, in which case the building fuse blows and possibly the lights go out. Some administrative personnel may take a dim view of this!

In our case we made out a very official interdepartmental memo stating that we needed some lay experimenters to determine the value of the device. Then on a second sheet (not to be read previous to experimenting) we put a bunch of questions like "Was the fuse good?", "Is it still good?" etc. leading up to a "Happy first day of April to you".

You can have a lot of fun with the "Little Gam Fuse Tester".

. . . W7CSD

What's New for You?

This column is devoted to short, timely items of interest to technically-minded hams. We'd like to cover new semiconductors and other components of special interest, new surplus, technical meetings, clubs and nets, comments about 73 articles, and so forth. All will give credit to the submitter. Please get all items in as soon as possible so that all readers will be able to take advantage of them. Keep them short, please. Send to: What's New, c/o Paul Franson, 38 Heritage

Rd., Acton, Mass. 01720.

Paul Franson WA1CCH

RTTY Circuit Boards

The circuit boards for RTTY gear on pages 34-37 of the January issue are available from the Harris Company, 56 E. Main, Torrington, Conn. The converter (decoder) is \$4, and the generator (decoder) is \$2. All etched circuit boards shown in 73 are available from the Harris Company. Write them if no information is given.

Propagation Chart

APRIL 1967

J. H. Nelson

EASTERN UNITED STATES TO:

GMT	: 00	02	04	96	08	10	12	14	16	18	20	22
ALASKA	14	14	1-1	7	7	7	7	7	14	14	14	14
ARGENTINA	21	21	14	14	7	14	21.	25	21.	21	21	21
AUSTRALIA	21	14	14	14	7*	7*	14	14	14	14	21	21
CANAL ZONE	21	14	14	14	î	7	14	21	21	26	21	21
ENGLAND	14	7	7	7	7	14	14	14	21	21	21	14
HAWAII	21	14.	14	7.	7*	7	7	7*	14	21	21	21
INDIA	14	14	7*	7*	7*	7*	14	14	14	14	14	14.
JAPAN	14.	14	7*	7*	7*	7	1-1	14	14	14	14	14.
MEXICO	21	14	14	14	7	7	14	21	21	21	21	21
PHILIPPINES	14.	14	14	7*	7*	7*	7*	14	14	14	14	14.
PUERTO RICO	14	14	14	14	7	14	14	14	21	21	21	21
SOUTH AFRICA	14	14	7	14	14	21	21	21	21.	21.	21.	21
U. S. S. R.	7	7	7	7	7	14	14	14	14.	14.	14	14
WEST COAST	21	14.	14	14	14	7	14	14	14	21	21	21

CENTRAL UNITED STATES TO:

ALASKA	14	14	14	7	7	7	7	7	14	14	14	14
ARGENTINA	21	*21	14	14	14	7	14	31.	21.	21	21	21
AUSTRALIA	21	21	14	14	14	7*	7+	14	14	14	21	21
CANAL ZONE	21	21	14	14	7	7	1.4	21	21	28	28	28
ENGLAND	14	7	7	7	7	7	14	14	14	21	14	14
HAWAII	21	21	14	14	7*	7	7	7+	14.	21	21	21
INDIA	14	14	7+	7*	7*	7*	7*	14	14	14	14	14
JAPAN	14.	14	14	7*	7*	7	7	14	14	14	14	14.
MEXICO	14	14	7	7	7	7	7	14	14	14	14	14.
PHILIPPINES	14.	14.	14	7*	7*	7*	7+	14	14	14	14	14
PUERTO RICO	21	14	14	14	7	7	14	21	21.	21.	21.	21.
SOUTH AFRICA	14	14	7	14	14	14	21	21	21.	21.	21.	21
U. S. S. R.	7	7	7	7	7	7*	14	14	14	14	14	14

WESTERN UNITED STATES TO:

ALASKA	21	21	14	14	7	7	7	7	14	14	14	14.
ARGENTINA	21	21	21	14	14	7	14	31	21	21.	21.	28
AUSTRALIA	28	28	28	31	21	21	14	14	14	14	tı	28
CANAL ZONE	28	21 -	14	14	14	14	14	31	21	21	28	28
ENGLAND	14	7*	7	7	7	7	7*	14	14	14	14	14
HAWAII	28	28	21	21	14	14	14	7.	14.	21	21	28
INDIA	14	21	14	14	7*	7*	7*	7*	14	14	14	14
JAPAN	21	21	21	14	14	14	7	7	14	14	14	21
MEXICO	21	14	14	7	7	7	7	14	14	14	21	21
PHILIPPINES	21	21.	21	14	14	14	7.	7.	14	14	14	21
PUERTO RICO	23	14	14	14	14	7	14	21	žì.	21.	21.	21.
SOUTH AFRICA	14	14	7	7*	7*	7	14	14	14	21	21.	21+
U. S. S. R.	7*	7*	7	7	7	7*	7*	14	14	14	14	7*
EAST COAST A	21	14.	14	14	14	7	14	14	14	21	21	21

· Very difficult circuit this hour.

* Next higher frequency may be useful this hour.

Good: 1, 4-9, 11, 13-15, 17-20, 24, 25 Fair: 2, 3, 10, 12, 16, 23, 26, 27, 29, 30

Poor: 21, 22, 28

VHF: 10-14



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Technical Aid Group

The first members of 73's Technical Aid Group are listed below. They are willing to help other hams with their technical problems. If you have a concise question that you think can be answered through the mail, why not write to one of the hams on the list? Please type or write legibly, and include a self-addressed stamped envelope. One question to a letter, please.

If you'd like to join the Technical Aid Group and you feel that you are qualified to help other hams, please write us and we'll furnish complete information. It's obvious that we need many helpers in all parts of the country and in all specialties to do the most good. While 73 will try to help with publicity and in other ways, we want the TAG to be a ham-to-ham group helping anyone who needs help, whether they be 73 readers or not.

Don Nelson WB2EGZ, EE, 9 Greenridge Road, Ashland, N.J. 08034. VHF antennas and converters, semiconductors, selection and application of tubes.

Tom O'Hara W6ORG, 10253 East Nadine, Temple City, Cal. 91780. ATV, VHF converters, semiconductors, general questions.

Stix Borok WB2PFY, high school student, 209-25 18 Ave., Bayside, N.Y. 11360. Novice help.

George Daughters WB6AIG, BS and MS, 1613 Notre Dame Drive, Mountain View, Calif. Semiconductors, VHF converters, test equipment, general.

Roger Taylor K9ALD, BSEE 2811 W.

William, Champaign, Ill. 61820. Antennas, semiconductors, general.

Jim Ashe W2DXH, R.D. 1, Freeville, N.Y. Test equipment, general.

J. Bradley K6HPR/4, BSEE, 3011 Fairmont St., Falls Church, Va. 22042. General.

Howard Krawetz WA6WUI, BS, 654 Barnsley Way, Sunnyvale, Cal. 94087. HF antennas, AM, general.

Robert Scott, 3147 E. Road, Grand Jct., Colorado 81501. Basic electronics, measurements.

J. J. Marold WB2TZK, OI Div USS Mansfield DD728, FPO San Francisco, Calif. 96601. General.

Hugh Wells W6WTU, BA, 1411 18th St., Manhattan Beach, Calif. 90266. AM, receivers, mobile, test equipment, surplus, repeaters.

Richard Tashner, WB2TCC, 163-34 21 Road, Whitestone, N. Y. 11357. High school student, general.

Wayne Malone W8JRC/4, BSEE, 3120 Alice St., West Melbourne, Fla. 32901. General.

Louis Frenzel W5TOM, BAS, 4822 Woodmount, Houston, Texas 77045. Electronic keyers, digital electronics, IC's, commercial equipment and modifications, novice problems, filters and selectivity, audio.

Michael Wintzer DJ4GA/W8, MSEE, 718 Plum Street, Miamisburg, Ohio 45342. HF antennas, AM, SSB, novice gear, semiconductors.

Clyde Washburn K2SZC, 1170 Genesee Street, Bldg. 3, Rochester, N. Y. 14611. TV, AM, SSB, receivers, VHF converters, semiconductors, test, general data.



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Hildreth Press

The changeover in printers has gone extremely smoothly and our old printer has been most cooperative in getting all our materials out to the new press in Illinois. Changing printers is a tremendous undertaking for a magazine because printing schedules are upset, huge amounts of material must be moved and accounts must be closed out. Hildreth Press, our previous printer, put forth a great effort and took care of everything smoothly and efficiently; in a matter of days our new printer was all set to go.

And then the biggest snowstorm in fifty years paralyzed the Illinois area; traffic came to a standstill, the pressmen couldn't get to work and little, if anything, was getting in and out of Pontiac, Illinois, including 73 magazine. Finally, however, the February issue hit the street. It will take us several months to make up the time lost because of the storm, but by cutting a little off the schedule each month, we hope to be completely back on schedule by the time you get the June issue.

Jim Fisk W1DTY

Aligning Decals

Having trouble lining up decals or dry transfer labels on that new piece of equipment? Without some kind of aid, it's a little tough to line up the labels on a panel and make sure that they are all parallel. One of the easiest ways to do this is to stretch a rubber band around the panel and align it with a ruler; all the decals placed along the rubber band guide will be perfectly aligned. This system has the advantage that no alignment marks are left on the panel after the labeling is done.

. . . Jim Fisk W1DTY

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Climbing the Novice Ladder

Part V: A stroke of luck for Judy

On the Wednesday following their last session at FN's shack wherein Larry and FN put Judy and Joe through an informal preliminary verbal exam, the kids toured the local ham supply stores in search of a receiver for Judy. At all three places, they unearthed several used receivers of conventional ham manufacture as well as a couple of the Command type of military surplus. With one exception, none of them seemed to quite fit the picture. Some were priced considerably beyond Judy's budget, a few were in somewhat questionable 'as is' condition and the Command sets, although moderately priced, would both require more extensive modification than desirable for a beginner. However, at Daly's Ham Shack they found a little Conar Model 500 novice receiver kit which had been 90% completed only 11 steps remained to be accomplished. Tim Daly explained that the young fellow who had purchased it initially had just been inducted into the military service and had left for duty before he could complete it. He had left the little rig with Tim to dispose of for him. The previous workmanship appeared to be neat and substantial and that remaining to do did not appear to be too difficult of accomplishment. Tim was offering it 'as is' at the very attractive price of \$20.00 which would not take too many spareribs from Judy's piggy bank. Tim agreed to hold it until Judy could talk to FN and get his opinion.

That same evening Judy's Dad agreed to drive her out to FN's place. After explaining briefly what she and Joe had found at the various stores, Judy said, "Gramps, both Joe and I think the little Conar would be a pretty good bet. I'm sure I could finish it and it's well within my budget. Joe phoned me just before I came out here tonight and said he'd run into Larry at the gas station and told him about it. Larry knew the guy who had started building it and had seen

the job. He told Joe that it sounded like a pretty good deal to him but to talk to you about it first."

"Well Judy", replied FN, "you say there are but 11 steps to complete in the instruction manual. I've got a Conar manual here, let's see what these really amount to". So saying, FN reached into his filing cabinet and pulled out the assembly and wiring instructions. Counting back 11 steps he said, "Actually this involves only installing and soldering in place five relatively simple pieces of wire. The other six steps have to do with the adjustment and alignment procedure. This, you'll remember I told you and Joe awhile back, is not always as easy a procedure as it may appear to be on the surface. The Conar is a straight superhet which is of course, desirable for selectivity and sensitivity. The schematic is conventional and with proper instruments, the alignment should be relatively simple as the adjustments seem to be well detailed in the book. I've got suitable test equipment and if we deecide this to be the rig for you, we can all get together here on my bench and bring the little chick to life. Let's do this; I've got to go to town Friday so suppose tomorrow I call Tim Daly and ask him to hang on to it until I come in and I'll have a look at what's been done and what's to do. After I give it the eagle eye, I'll give you a definite 'yeah' or 'nay' . . . what say?"

"Oh fine, Gramps, I'll really appreciate it and if you say go I'll pick it right up and we can get busy on it".

As FN nodded agreement, Judy's Dad surprised them when he said, "Say FN, if Judy goes for this little receiver, mind if I come along when she works on it? I'm gettin' kinda interested in this ham stuff myself after listenin' to the kids drone away with that code hickey they've got out in my storage shed".

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"Well, blow me down, Tom," replied FN, "I never thought the radio bug's stinger was long enough to penetrate that tough old carpenter's hide you walk around in; sure thing, drag yourself right along if Judy gets going on this and bring Edna with you . . . she and Ma can swap valley gossip while we're cluttering up my bench . . . glad to have you".

True to his word, FN called Tim Daly who agreed to hold the little receiver until FN dropped in on Friday and checked it over. His inspection indicated that while perhaps not exactly a professional job of workmanship by the previous builder, it was substantially done, connections well soldered and the general assembly indicated that care had been used throughout. Telling Tim that he would give Judy the green light on it. FN finished his errands in town stopping at Judy's place on the way home and giving her his decision. Her Dad was busy with a kitchen drain board job on the other side of town but Judy was sure that he'd take her to town in the morning and pick up the Conar. FN invited her to bring it right out to his shack then if she'd like to get started on it but first he cautioned her not to neglect her study of the examination material reminding her that the following Saturday both she and Joe were due for their formal code exams and shortly thereafter, the written portion. "Oh, I won't Gramps; I'm still reading myself to sleep with the books every night and I've got code, rules and regulations practically running out of my ears" she laughed.

That evening, Joe phoned Judy to check on progress and she invited him to join her at Tim Daly's in the morning and they'd pick up the receiver and he could accompany she and her Dad to FN's and get in on a bit of the final completion of the little rig. Joe eagerly agreed and both kids looked forward with eager anticipation to an enjoyable session on FN's bench.

As Judy had surmised, her Dad readily agreed to take her down to Daly's, pick up the receiver and then out to FN's shop, so the next morning Judy cranked the tail of her piggy bank until it had spewed forth twenty of the closely hoarded dollars from her summer odd jobs. Tom Mansfield backed the station wagon out of the garage and they took off for town. Joe was waiting so it was but a matter of minutes to empty her poke into Tim Daly's hand, take a re-

ceipt, pick up the little box and head for FN's. They stopped by Judy's place to pick up her mother who would visit with FN's XYL while Judy and the men folks delved deeply into Pandora's electronic box.

FN started the session with, "All right now; you kids take the assembly manual, figure out the five wires you will still have to install and get them placed and soldered. Tom, you hang over their shoulders and soak up a bit of this stuff . . . you asked for it you know and you'll soon see what you've let yourself in for". FN chuckled and continued, "I'm going to be clipping the hedge out back; when you're through with those wires let me know and we'll lay out the test gear and go through with the alignment."

Some forty five minutes later both young-



Judy and Joe went shopping for a receiver for Judy.

sters were satisfied that they had it finished and Joe went out and rounded up FN. He too considered the wiring satisfactory and announced, "We've reached the point now where we're ready to give it the initial 'smoke test'; you know, plug the cord into an AC outlet, turn on the power switch and 'tune for minimum smoke' . . . go ahead Iudy". Somewhat dubiously she was about to gingerly push the plug into the outlet when FN stopped her with, "Uh uh, Judy; check your panel switch first and be sure it is in the 'off' position; always do this with any piece of gear before you plug it into a power source. Just like your Dad's FM radio, the power switch here is part of the volume control; click the pointer to the 'off' position. That's right, now plug in the power cord". This done. FN carefully scrutinized the chassis for a few moments then said, "No smoke; so far so good. Now click the power switch to 'on' and let's take another look; good, the little panel indicator lamp glows and we blew no fuses. All of the tubes show a normal dull glow inside their envelopes so apparently all heater circuits are correct. Now advance the volume control slowly clockwise; the tubes should be warm enough now to produce some background noise in the speaker. Yep, there she comes . . run the volume clear to maximum; the background increases normally as you go . . fine. Turn the volume back down a bit now and just let her set and 'cook' while we haul out the test gear for alignment; we'll use a signal generator and a vacuum tube voltmeter for these final steps". Just then FN's XYL announced lunch for all hands on the patio and, at FN's direction, Judy turned the power switch to 'off' and pulled the power cord from the outlet. "Better we get a bite or two under our belts then we can come back and go right through the final steps without interruption" and, after washing up, the 'junior scientists' joined the oldsters at the picnic table.

After bountiful replenishment of the body fuel, FN stoked his trusty briar and when she was drawing well, sleeves were figuratively rolled up and the curtain was ready to rise on the final act. "Here's the test equipment, kids; Joe knows how to use it from his class work; the book tells you just what to do with it, where to connect it and how to use it. I'm not going to say a word; simply follow the instructions and I'll stand

by in case you hit a puzzle or two. Tom, you can watch, but don't touch; you're not going to sneak into the ham hobby by jumping into something right in the middle like this. If you get serious about this ham business you're going to have to start from scratch like the young 'uns did. Ok; get going kids".

Step by step with an occasional question to FN to clear a doubtful point, Judy and Joe worked through the various tuning slug adjustments. At FN's suggestion, each would carry through one step and the other would repeat the process as a double check before proceeding with the next. They discovered that meticulous care was necessary as they proceeded; many of the adjustments were sufficiently critical that the peak performance point could be easily passed over. Obviously alignment was not a procedure which could be handled on a hit or miss' basis with any expectation of realizing the full potential of a receiver. Ultimate performance could be reached only by devoting plenty of time to careful adjustment and simultaneous checking of meter indications. At last however, the final screw had been turned, a re-check of some of the operations performed and with a couple of relieved and profound sighs, tension relaxed. "Well, Gramps, what you think?" queried Judy, patting her copper-hued locks back to some semblance of a girlish hair-do.

FN smiled and said, "Bravo! There were a few times there along the line where I was tempted to shove in my two-bits worth but I decided to let it ride. You've done rather better than I had expected and you have the little rig in pretty fair shape right now to drag in a pretty good assortment of signals . . let's see if it will. Tom, I'll relax a bit and let you stick your finger just a little way into the pie. Disconnect the test leads . . . ah, ah . . . remember to pull the AC plugs first . . . and set the test gear to one side. Now take these two clip leads and connect the antenna and ground terminals of the receiver to these two terminals on my bench. That will connect the receiver to my test antenna; just a random length of wire out to the old maple tree . . about 65 feet, and to my ground system . . the cold water piping of the house in this case. Now Judy, it's your receiver so the honor of ushering in the first signals should be yours. Again, follow the

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Joe, Judy and Judy's Dad Tom finished the last steps in building the Coner receiver.

procedure outlined in the book, setting all of the controls to the specified positions. Now, slowly turn the main tuning knob slowly across the dial scale." Wow! From the myriad of peeps, whistles and birdies of every imaginable pitch which rattled the speaker, one would think that an emergency evacuation of a monstrous apiary was being staged!

Completely awed, Judy's jaw dropped, her eyes momentarily glazed and she slowly turned to FN with a blank and unbelieving stare. Laughingly he said the magic words, "Well girl, you've really made it; you grabbed the bear by the tail but you can relax and let go now. Let's see what we've got". Reaching across to the tuning knob, FN picked off a shrill high-pitched signal of more than adequate room volume and far above the speed capacity of the kids at this stage. Reducing the gain to a more comfortable hearing level he announced . . . "That's NSS at Annapolis, Maryland . . a Navy station. Here in Ohio we consider that as practically local; let's keep going. There . . another Navy . . NAA up in the state of Maine . . . we're doing better. Now, who's this? CKN . . . that's still better . . .

out on the West Coast in Vancouver, British Columbia . . . Canadian Government station. So, we're in the commercial and military portion of the 40 meter band . . let's see if we can chase down the amateur segment. Should be about here . . nope, that's a foreign short wave broadcasting station although the dial reads in the amateur spread. Could be though as many of those furriners show total disregard for international frequency assignments and just bust through wherever it suits them. Or, it could be that your dial pointer actually is off and the BC station is in a legal spot. Remember, we have made no effort to relate the pointer to the dial scale as yet; that's a minor adjustment and is explained clearly in the book. Before you tackle that let's see if we can grab a few ham signals somewhere on the dial to give us a cue which way to go. We'll tune slowly over the whole scale; commercial, commercial, Navy . . a voice but it sounds like a Mexican short wave BC station. Here's another voice . . wait . . that's in English . . put the BFO knob on AM and retune slightly; fine, and it's a ham calling "CQ 40"; listen. A WA6 . . . that's out in California . . Sacramento, he says. Well, we've hit the high end of the 40 meter ham band then; phones in that band are authorized to use the frequencies from 7200 to 7300 kg, or if you prefer, kHz, but your pointer is almost at the high end of the scale . . about 7600 kHz for a guess. Means vou're going to have to back the pointer up a bit and at the same time hold the position of the tuning capacitor plates. Suppose we pick the middle of the amateur 40 meter band for a starter . . 7150 kHz. Now there are two ways to make this adjustment and you're going to have to juggle a bit between them. The manual is very clear in explaining both the mechanical adjustment involved in shifting the pointer as well as the electrical setting to be achieved by adjusting the slug in the proper tuning inductance. I'm going to set my signal generator going at exactly 7150 kHz with the 400 hertz (cycle!) modulated tone turned on; there. Now tune in that signal; that's it . . that steady drone. Your job now is to keep that tone and adjust the pointer both mechanically and electrically until it indicates exactly 7150 on the scale. Go ahead now and follow the procedures described in the book."

Never a speedy process, this took a bit

of time and an occasional tip from FN but after some ten minutes of careful adjustments. Judy had it made and her beaming face reflected satisfaction. After an 'OK' from FN he continued, "Suppose, Judy, that you take a little breather now and we let Joe take a whirl at doing the same thing but on the 80 meter band. From here on the adjustments will be purely electrical so that we don't upset the mechanical position which Judy has established for the pointer. Joe, set your band switch on 80, put the BFO back on CW and follow the book." Again an encouraging number of signals though not so many as on 40; 80 meters in the daytime is not the best band in the world except for relatively local contacts but there are generally sufficient signals to permit the adjustment process. Hams, except for the novice sector and maybe a few phones are somewhat lacking but Joe had soon established a starting point and using the signal generator, this time set for 3725 kHz, took about the same length of time to corelate the pointer and dial with the tone and adjusting only the tuning slug in the proper coil. All that was now left was the 15 meter band and this being somewhat trickier in balancing due to the higher frequency. FN worked with both youngsters to bring this novice 'DX' band into proper play with the help of the scores of signals present as the band was 'open'.

It had been a rather rugged but very fruitful several hours and successful completion of the receiver was celebrated with a heaping mound of Grandma's famous doughnuts and a jug of fresh cider which FN produced from a dark corner cupboard in the cool basement. "What a day" . . . "Boy, that was rough" . . . "Whew; I think I know a *little* somethin' about a superhet receiver now" . . . and similar outbursts were bandied about. Soon the doughnuts were reduced to a plateful of crumbs, the cider level to a significantly new low and relaxation was complete. By now the afternoon was well along and as Joe had come out with Judy's family rather than on his Honda, Tom would take Joe home and stop in town on the way back to pick up 100 feet of antenna wire and a couple of insulators; he and Judy were determined to get up at least a temporary antenna of some kind as soon as they got home! Why waste Saturday evening on some dumb gunplay on the boob tube tonight?

All loaded, the receiver carefully held on Judy's lap (just try and take it from her!) the little band took off amid a chorus of " 'Bve Gramps and Gran . . . thanks for the help FN . . . sure had an enjoyable day". FN had instructed Judy in the adjustment of the antenna trimmer once she had the receiver connected to her own antenna and had reminded both kids that the following Saturday was their formal code exam day . . . don't get off the practice track meanwhile. They had earlier assured him that they had both sent their request for license application forms to FCC a week ago and hoped to have them to bring to the code exam.

It had been a somewhat wearing day and FN, though a bit on the weary side, had thoroughly enjoyed joining in the enthusiasm of youth but now sought a bit of peace and quiet through a little 'rag-chewing' with a few of his old cronies on the air until the welcome chow call ended the working day.

. . . W7OE

Next month: The formal code exam and a discussion of transmitters.

Dating Batteries

Too often it happens that when we use a piece of gear such as a portable transceiver, a transistor radio, or a flashlight, its batteries will pick that moment to take their departure to the Great Beyond. One good way to minimize these annoying occurrences is to write the date of purchase on each battery. With that date inscribed on the batteries, one can tell at a glance approximate-

ly when they should be replaced.

It is best to write the date on self-sticking unprinted labels or pieces of masking tape and then sticking them to the batteries. On batteries with cardboard cases, the date may be written in ink directly on their cases. A rubber stamp is also suitable for cardboard cases.

. . . William Bakewell WB6GHB

WTW Gets Under Way

You fellows who have been waiting to get into the WTW DX award should start right now because things have started rolling, interest is building up fast and the cards are starting to come in from all over the country. So far none have arrived from overseas stations, but you can be sure that many of them are working on it at this time. I had no idea that anyone would qualify during the first year (actually only eight months), but as usual I guessed wrong because many fellows have already sent in their cards and more are arriving as each week goes by. I wish I could enter this one but I have disqualified myself because I don't want anyone looking down their nose at me nor do I want any suspicion that there was any monkey business. Up to now I have personally checked each QSL card and they have all looked good so far, but we are putting everyone on notice that if the dates and call signs on each card are not easily readable they will be rejected. We don't want anyone getting peeved at us about such matters, but I want to put everyone on notice that we are going to be looking at every card sent to us with a strong reading glass and if any looks even the slightest bit "phoney" we will reject it without batting an eyelash. We suggest that you carefully look over your cards before submitting them and get duplicates of any that are a little fogged up, blurred, call sign changed, dated changed, etc. This will save us the trouble of rejecting the cards at this end and at the same time it will keep us from even the slightest suspicions of any of you. So far I am glad to say that all the cards submitted have looked ok, but sooner or later I am sure some questionable ones will show up.

When you fellows send in your cards for WTW how about sending along a few photos of yourself, your station, antennas, and some biographical dope so we can put it in 73 when writing up your reports. Presently quite a few fellows have qualified for WTW and as time goes on we expect the country totals to build up fast. Getting the cards has been a problem from some stations, but they can be extracted because I have seen all the cards submitted and this shows that it can be done. If you are being bothered by not receiving QSL cards, maybe you have worked the wrong stations! I would like to emphasize the importance of filling out your lists of QSL's that you send to me or any of the verification clubs. We would like for these lists to be done the same way by everyone who submits cards to us. Later on we will have some printed forms for everyone to use, but for the present time use standard 3 by 5 inch filing cards; we will let you know when the forms are available.

Put your call sign and address on each 3 by 5 card along with the date that you mailed the card. Please include your claimed contacts in the order of their prefixes (alphabetically), the date of the QSO, and the country you claim the QSO was with. I have received quite a few cards with no countries listed or dates. If this information is not shown on your filing cards in the future, the whole kit and kaboodle will be returned to you without any record being made that we have received them. This will place you further down the WTW list with a higher serial number on your WTW certificate. I'm sure you don't want this to happen.

We have issued nine more WTW certificates since the list we published last month. These fellows all got low serial numbers on their WTW certificates and one of these days they will be very proud to show these low serial numbers to the other fellows. Many more of you can do the same thing if you hurry and get your cards to me. Although I didn't mention it last month, note the Dan Redman K81KB and Jim Lawson WA2SFP each have two certificates: Dan has one for CW and one for SSB while Jim showed with 100 pasteboards for SSB on both 20 and 15 meters. These are no mean feats when you consider that it was all done in less than a year.

Bob Wagner W5KUC, "Hop" Hopple W3DJZ and Gay Milius W4NJF have gone one step further. These fellows have gone

all out on 14 MHz SSB by working and getting QSL's for 200 countries in less than one year. This just goes to show that it's not impossible if you work stations that QSL promptly. On the other hand maybe these fellows have some secrets about extracting cards from some of the toughies?

Are we going to count K1IMP/KC4's operation on Navassa? You can bet we will count it—they were there weren't they? In the future you can be sure that the WTW Awards Committee will count all such operations if the country is on the WTW countries list and the operator was actually there. Please pass this info on to any of your friends who are planning a DXpedition to some good spot. If the country is recognized by one of the national amateur radio societies, WTW will give credit and

their trip will be worthwhile.

Next month I hope to have a complete list of all DX Clubs which we have appointed for checking your WTW cards. This way your cards won't have to be sent so far; you'll save on postage and there will be less chance that your cards will get lost in the mail. We have quite a few check points already, but we are still looking for DX Clubs in the following areas: W1, W2, W5, W8, W9, WØ, Africa, the Middle East and South Asia (India, Pakistan, Iran, etc). Any volunteers?

We still have not heard from anyone for either CW or SSB on 10, 40, 80 or 160 meters, so certificate number one is still QRX for some sharp operator. Number one on 15 meter CW hasn't been claimed either. so fellows, join the WTW fun; come on in, the water's fine.

WTW Certificates Issued Since Last Issue

SSB WTW-200 Number 14 MHz SSB "Hop" Hopple W3DJZ 14 MHz SSB Gav Milius W4NIF SSB WTW-100 James Edwards 14 14 MHz SSB WA5LOB James Lawson WA2SFP 21 MHz SSB 15 14 MHz SSB 16 Bill Galloway W4TRG Olgierd Weiss WB2NYM 14 MHz SSB 17 14 MHz SSB Jose Toro KP4RK 18 14 MHz SSB Joe Hiller W40PM 19 Gerald Cunningham 20 14 MHz SSB W1MMV

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Gus: Part 22

At the end of my last "chapter" I was with John, 9U5JH in Burundi. My stay with him and his small family was a FB one, plenty of good food, sleeping all day and operating all night. I wonder how it would have been if 15 and 10 meters had been open so I could also stay up all day to work the fellows? I suppose you could work yourself to death with all the bands open like they are right now. Maybe soon I will get to know if I get away on another trip. Don't be surprised if this happens. Right now my little weekly DXERS magazine is working me 14 to 16 hours EVERY DAY, but I am sure it will smooth out and I will be able to get away on another trip, sooner or later. During that time there will be a single page bulletin to keep all the DXERS informed.

After about five days of operating in Burundi I asked John about how things were up in Rwandi and was told that there was some "political" trouble up there. I later on found that there is "political trouble" most of the time in most of those countries down there. Sometimes it's bad and other times it's sort of mild. John said he would drive me up there the next day. We were up with the chickens and away we went on those rough dirt roads they have there. It's up one hill and down another all the time. Many natives was passed on the road. Where they all were going I had no idea. Some were loaded with quite large bundles on their backs. Many had very large stalks of bananas, I suppose carrying them to some market somewhere. Who bought them I don't know, because everyone there seemed to have lots of banana plants all around their houses (grass huts).

After about a 25 or 30 mile ride we

arrived at the border of Burundi and Rwandi. The Burundi guards just waved at us, but when we entered Rwandi about five guards stepped out with their rifles and pistols in the very middle of the road. They make us get out of John's Chevy and led us into the little Border Guard house where we had to answer endless questions as to why we were going into Rwandi and what our business was there. We kept insisting we were going there to visit a friend. They wanted to know who he was and what did we want to see him about. John said we were going to visit Father Florin 9U5BH, and that he was an old friend who we had not seen for a long time. I all of a sudden got a "brilliant" idea. Why not take some pictures of all these guards with me in their midst. We all trouped outside, lined up and took lots of pictures. I explained to them these were color pictures and would have to be sent to the USA to be developed. I think all this picture taking business sort of took their minds off all this questioning. All the radio gear was in those Samsonite suitcases in his car all this time, and I am sure if they had made us "open up" we would never have been allowed to enter Rwandi. It seemed there was two political factions in this country and it was nip and tuck with them. The border guards finally let us thru with us promising to send them some of the pictures when they were developed.

Which reminds me, I never did send those pictures to them. In fact I lost their names and addresses a long time ago. At least my intentions WAS GOOD AT THE TIME!

After passing into the country we started passing different group of people along the

road, dressed as if they were going to a party in their finery, and that "out of this world" hair-do they sport down there. Right down to the top of their head they had shaved a gap about one half to one inch wide and on each side they piled up their hair. Usually one side was a lot higher than the other and some of their hair-do's looked sort of like a hat at a distance. The people we met along the way started waving their hands at us I than noticed when they did this some of them would hold up one finger and others help up three fingers. I asked John what did this mean and found that this signified what party they were for. John suggested that we always wait and let them wave first and whatever fingers they held up that we do the same. John further explained that he had heard of some people in cars who made the wrong gesture and got a rock thru their windshields. Well being an old "hand shaker from way back" this was right up my alley. I became one of the boys from then on. Another few miles and we came upon a very large crowd of people out in a field by the road. A speaker was on a little platform, waving his hands all around and they had a VERY LOUD speaker system blasting away. Sort of "war looking" dances was taking place all over the place. I yelled to John, "stop the car". We stopped and I grabbed my camera to get some shots of all these shennigans, in fact I did actually get a few shots, and the crowd then saw us and we became the center of attraction and their looks was a long ways from being what you would call friendly. John said, "Gus, let's get away from here right now, I don't like the looks they are giving us." I agreed with him and he stepped on the gas and away we went like a scared jack rabbit. That was one place I were not overly anxious to hang around. Mind you this was in what I would call "wild country" of mid-Africa. Our intention was to go on to the capital city but when we stopped by to have a short visit with Father Florin and began to inquire about the possibilities of an operating permit and after Father Florin told us how unsettled things were up in the capital, and when he "invited" me to stay with him-I right then and there decided that half a loaf was better than no loaf at all, and I unpacked the gear. I was shown my own private room where all the other Fathers lived, and told the time to be at the eating table for all my meals. Father Florin and

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I headed for the radio shack some few hundreds of feet away with all my gear. I found that Father Florin's knowledge of English was extremely limited. His native tongue was Flemish. We could not do much talking but we most certainly tried, me in English and him in Flemist! That was some "eye ball" QSO, but you know amazingly we somehow did get thru to each other. I still wonder how we did it. I suppose if you wave your hands, yak and yak some more, roll your eyes, wiggle your ears, thump your nose enough you can finally get thru to anyone. Father Florin had quite a big batch of equipment there, all on 15 meter AM phone when I was there and he offered to let me use it. I explained to him that I would rather use my own. He had up a three element beam and nice "V" beam on the USA. We cleared a space on his desk and wired up my gear, Everything was checked out and away I went signing 9U5BH. All my followers were hand, quite a few saying I was a new one for them (which I still doubt!). After 20 went out I tuned up on 40 and it started all over again (I built up a little antenna tuner to use the "V" beam on my 52-ohm pi output gear). I even tried some 80 meters but did not have too much luck with it. The bands stayed open up till about 4:30 AM everynight. I had asked Father Florin about lions around there and he said there were a few now and again. This made my little walk from the radio shack to my room interesting each night at around 4:30 AM. I did actually hear some lions in the distance doing a little roaring, but am glad they were some distance away from where I was. I feel absolutely safe as long as they were some other place. During the daytime you are safe in lion country since they do their roaming around during the nightime. This place where Father Florin staved was a very large Catholic school with some 2.000 children going to school there, quite a number of them living in the school and the rest in the village. The ages were from 6 years to about 16. I wonder if Father Florin is still there, in fact I wonder if the school is even there with all the "changes" taking place in Africa these days. You know Burundi and Rwandi join the Congo, and Father Florin is from Belgium, and some of these Congolese don't exactly love Belgians. The Congo is very close to where Father Florin's school is located. All of the students there are natives, many different tribes being

represented by their different hair makeup, dress and many of them, they say, can hardly even speak to each other. Father Florin has a little "Broadcast Station" there which had a pi output network, which he had connected to the "V" beam, one side of the "V" being grounded. Naturally it would not load up, so I built a tuner for the "V" beam and we were in business with it. Everyone including Father Florin was delighted and so was I. He had a very large assortment of phonograph records and wanted to broadcast a few hours each day for listeners in the village and nearby.

My stay with all the Fathers there was most enjoyable. Radio conditions were very FB and when it came time for me to depart he insisted that I come back by there after I had visited other parts of Africa and spend three or four months with them. Over the air I even got someone to send him a modulation transformer for his "broadcast station". I hope it arrived OK after I left. It would be fine to visit him again and see how he is progressing with his BC station if he is still there.

John drove back from Burundi and picked me and my gear up and away we were off back to his QTH. We drove one night over to Usumburu and visited the head of their Posts and Telegraph asking for permission to use my own call sign instead of John's. We were given his permission to use the call of 9U5ZZ at the QTH of 9U5JH. I only stayed there upon my return for about three or four days using that call sign. One QSO I had from there I well remember. It was a SSB QSO with ZS6ANE in Johannesburg. He asked me if I would like to go down to Bouvet Island? Boy this was for me you can be sure! I was told that it would cost me though and this put a little freight into me and my close budget. I very "meekly" inquired "how much", and was informed that it would be \$3.00 per day to pay for my food while on the ship. I was also informed that the ship was going there by way of Tristan da Cunda and Gough Is. This development was something I most certainly had not even thought would turn up. ZS6ANE further told me he had inquired to LA5HE about him going to their authorities to try and get me a license to operate from Bouvet also saying he had already fixed things so that I could use the call sign of ZD9AM from Tristan de Cunha and Gough island. I was told to be sure and be in

Capetown on a certain day, a day that was not too far away. This cut my stay at Burundi. John told me he would drive me to Kigoma in Western Tanganyika, quite some distance from where we stayed in Burundi. With my itinerary all of a sudden tightening up with this deadline to meet the ship in Capetown all my stops between Burundi and there had to be cut to the minimum. The way transportation is in that part of the world you have to allow for delays (oh yes, you will have delays, this you can be sure of). Early the next morning (about 1AM) we were off. I had to get to Kigoma that afternoon or miss the twice-perweek train. Missing this train WOULD PUT ME LATE IN CAPETOWN, and THIS COULD NOT BE ALLOWED TO HAP-PEN, and worst of all MISS the trip to BOUVET ISLAND.

Next month: The trip to Capetown.

. . . Gus

Antenna Materials from Sears

If you browse through the Sears catalog, you find many items of interest to the antenna builder. The prices are very reasonable and delivery is as close as your mail box. For ground systems and ground leads, Sears has #8 aluminum ground wire at 50 feet for 95c; and to go with the wire, they offer % inch copper-clad steel ground rods 6 feet long for 89c. Compare those prices with your local hardware store! In addition, they stock steel antenna masts up to fifty feet, steel guy wire and lightning arresters.

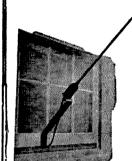
In the Sears Farm Catalog there are even more interesting offerings. For long wire antennas and extensive ground systems, you can buy a half mile spool (2640 feet) of #18 copper-covered steel wire for \$9.25; that figures out to about a third of a cent per foot. Be careful about using that #18 in a single strand long wire antenna, better twist two strands together. If you want aluminum wire, they have 14 mile spools of #13 for \$8.95. And-for tower installations, steel fench anchors are available. These little jewels are perfect for anchoring guy wires. Four sizes are available from a small 15 inch job that is rated at 450 pounds to a 48 inch unit that will withstand a ton and a guarter; reasonable too, check and see.

. . . Jim Fisk W1DTY

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tion for amateur radio in Washington. And they should not suffer confusion over the role played by Bob Booth W3PS, the ARRL counsel in Washington, whose job is to present ARRL petitions to the FCC. Bob cannot, unfortunately, call up a Senator or a Representative and push ham radio for this is prohibited unless he is officially registered to lobby for us . . . and he isn't. Not that Bob could handle any such assignment anyway, for he has a full compliment of other clients and the ARRL is just one of many filling his time with their problems with the FCC.

The other major hobby groups have long since established headquarters in Washington and have strong and enthusiastic voices to protect their interests. I don't have to tell you about the tremendous results the American Rifle Association has had in convincing Congress of their members' points of view.

While there are many areas where the ARRL should be improved, I think that the most valuable long range results for all of us would be the long needed establishment of their Washington Office and the first real representation of amateur radio by the League.

I cannot answer all of the rationalizations that will be brought up against the above in this column. I can forsee a few . . . like maybe "it will be too expensive." Balderdash. Let's not hear cries of poverty while they have a half million or so sitting around in banks and stocks. That money should be out there working for us, not gambled on the market.

Pressure in Washington would not only work to the benefit of amateur radio here in our own country, it should also help to protect us internationally. The basic frequency bands are set by ITU agreement and if we are to hold onto our bands we must have all the support we can get in the ITU . . . and this means first and foremost complete and unequivocal support of our own government. In the last ITU conference in 1959 this was conspicuously absent and only a virtual miracle saved our bands from serious amputation. Are we going into future ITU conferences with the same lack of support? Unless we put pressure on in Washington it is going to be a repeat.

Not that the ARRL couldn't do a lot for

us internationally too. In my November editorial I explained about the need for gear in India, which has one of the best possibilities for expansion of ham radio in Asia, held back only by the almost complete lack of equipment. I sent copies of this editorial to the ARRL Directors and asked them to consider the proposal for collecting used ham gear in the U.S. and sending it to India, pointing out that I was well aware that a great many objections could be raised, and that I thought I had adequate answers for any objections or problems forseen. One director said he would do something about it if there was enough pressure from his constituency. One other said he thought the idea unworkable. Huntoon wrote and said that this was old hat . . . the League had considered a lot of stuff like that in the past and decided against it.

One of the biggest problems holding back the expansion of amateur radio in most of the Asian and African countries is the lack of equipment. We can get hold of a 50 kilowatt station easier here than some chaps over there can get a simple transceiver. We have tons upon tons of used gear sitting around in our garages, attics, cellars and in closets that could make a world of difference in a hundred countries. They don't care if it works or not . . . you get the gear to them and they'll get it working. When a transformer burns out in India they don't send for a new one, they take it apart and rewind it.

The ARRL could, if they wanted, spread amateur radio all over the world and spark the operation of thousands of new stations. In every one of the countries I recently visited that has a small ham population I found that there are many eager fellows who stay away from amateur radio because of the gear problem. The ARRL could easily collect equipment through the vast organization they already have set up and which reaches into every corner of our country.

The League history of helping overseas amateurs is a sad one of dropped balls. Their faint attempt in 1962 to work with Rotary International resulted in one single station being sent, I've heard, to a priest in Mexico. In 1963 the League tried to set something up with the Peace Corp, but this, too, came to naught after a couple of unproductive meetings. I gather that the Peace Corps wanted to set up a technical training program and the League held out for pro-

viding complete ham stations or nothing. And that's about it.

There is almost always a way to do something if you really want to do it. I found India most anxious to cooperate in the matter of receiving amateur radio gear and willing even to set aside customs regulations to get it. In other countries I found good possibilities of working through U.S. AID, a section of the State Department. Elsewhere I found the U.S. ambassadors quite interested in helping and there is a good possibility that gear could be furnished through our embassies. And so it goes . . . there are always problems, in anything . . . the successful executive is the one that solves them and achieves the ends in mind. Right now we need amateur radio in as many parts of the world as we can manage.

In addition to helping electronics and communications expand world-wide through our equipment help from the U.S. we will also be putting money in the bank toward foreign support in our frequency allocations of the future. I gather that the main hope at League HQ these days is that the ITU will be so politically strife torn that it will be unable to get together to take away our bands. This is, of course, a possibility . . . but should we bet our whole future on this chance?

By all this I don't mean to be disrespectful of the handbooks and code practice buzzers the League has sent to Liberia and Nigeria (donated by Johnson Company, bless them). This is good and no doubt has been responsible in some degree for the recent increase in amateurs in these countries. But what seems to be needed the most is gear and I don't think we will see any remarkable steps ahead until a program for sending equipment overseas is achieved.

DXCC Changes?

More and more of the DX clubs around the country are calling for an overhauling of the vague and conflicting rules of the DXCC award. The recent decision of the League not to accept the K1IMP/KC4 operation for credit toward DXCC seems to most observers to be nothing more than an attempt to get even with Don Miller for his upsetting of their Honor Roll apple cart.

Let me assure you that there will be no petty political maneuvering with the WTW award. If a station is in a country it counts for that country. There is no question what-

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ever about Herb and Don actually being on Navassa, so the operation is valid for the Worked The World award.

Then there is the matter of a few DX stations that aren't just exactly where they say they are. The ARRL has set a policy of accepting these as counting for the country they claim to be in rather than the one they are actually in . . . and perhaps this is a good solution to the problem. I'd be interested in any good constructive ideas on this subject. I am uninterested in any emotional sanctimonious moralizing. This is something the League will have to eventually face too, for it is getting now to where an adverse decision on this could shuffle some honor rollers from ten to twenty countries.

A few days ago I got a call from K4ZBJ/MM. Seems that Jim is on a ship that spends a good deal of its time going back and forth between Fernando Po and Camaroon. Hmmm, says I, both of those are fairly rare, do you know that MM operation within the territorial limits of those countries counts as a contact with the country for the WTW award? Again, the thinking is that if the station is there, then it should count. This gets away from any political decisions as to who is legal, who isn't, etc. Look for Jim from those countries from now on . . . and any other MM's in unusual territorial waters.

The K1IMP/KC4 decision by the League is insupportable when you consider that they do accept contacts for DXCC with totally unlicensed stations in other countries. For instance, I am willing to gamble that they are accepting contacts with 9N1BG for credit. To my knowledge, and I was there not long ago, this station is unauthorized. This is not to say that there is anything wrong with the station or the operator . . . it happens that no public officials in Nepal have the slightest



Jim W5PYI (right) and I try noomie hamuph in Baghdad to fight off a chil).

intention of authorizing amateur radio . . . but have, on the quiet, encouraged amateurs to go ahead and operate, just don't ask for official permission. This same system is used in other countries and should be recognized as a fact of life.

W2NSD/YI

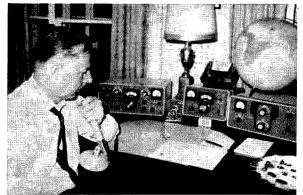
When I mentioned on the air that I was going to be stopping off in Iraq after leaving Syria and Lebanon a lot of fellows wanted to know if I would be getting on the air. I explained that if I could locate a rig in Baghdad I would, otherwise it was the tourist route for me. I did not take any ham gear with me on my trip, figuring that the problems of border crossing were bad enough as it was without being mistaken for a spy or something. I did manage to get on the air from most spots by visiting local ham stations. Nothing turned up in Baghdad, so I spent my time sightseeing.

Jim Cotten W5PYI and I arrived in Baghdad at night. We were a bit unsettled to have the customs officials pull about twenty boxes of cigars out of an arriving man's suitcase right beside us. The chap had forgotten to declare them. I suspect that he is sitting somewhere right now rueing this oversight.

We took a taxi into town with a chap that seemed to know his way around the place. Lucky we did . . . he bargained with the taxi driver for the fare and the trip cost about 50c. Later we found out that taxi fares are generally as high as the drivers can get. And if you make the mistake of taking a taxi on the promise of the driver that you can pay whatever you feel at the end you will have a real keepsake of Baghdad to remember . . .a royal gouging as he asks \$20 for the ride and holds out at \$10 for the police. etc. The gathering threatening crowds do not encourage you to hold out since he is screaming in their language and no one seems to know yours.

Baghdad is h o t. Our air conditioned room in the Baghdad Hotel was in the 80's and we slept fitfully. Outside it was in the high 90's at night and around 120° or so in the day. Try hiking around in that, fellow tourists.

Actually, other than the heat, we found Baghdad to be a nice place to visit. Unfortunately it was hard to think about anything other than the heat. Orange soda (Gus digs his Coke, I'm an orange fan . . . to each his own) was only about 4c a bottle so I survived



Hank Meyer EP3AM, the American Ambassador to

staggers through town by frequent orange soda stops. The native beverage didn't look all that good . . . large pans of watered yogurt with a block of ice in the middle. No doubt it is delicious. I may never know.

I did chance the ice cream being made by sidewalk venders though . . . great! And I kept up my sampling of various types of baklava (a pastry soaked in honey) at every opportunity.

The people were very nice to us and many asked if we would like to take their pictures. How different from Africa where the hands come out palms up as soon as a camera comes into sight. You take a picture of a street corner and several people come up menacingly asking for two shillings because you took their picture. Not so in Baghdad . . . they pose and are happy to be of service to you at no charge. I thanked several of them by presenting them with a Polaroid of themselves, but after a few of these the word spread and I found myself almost buried in small kids who wanted their picture taken.

Jim and I took a tour about 60 miles from Baghdad to Babylon and about got our brains fried inspecting the tower of Babel, the summer palace remnants, and other historical trivia.

We had been wondering about the big posters that had suddenly appeared around the city . . . the mobs in front of some government buildings . . . and other puzzlements. We got the word, at last. Seems we were in the middle of a cholera epidemic and didn't know it. All borders to the country had been sealed . . . fifty dead outside of Baghdad, about 15 in the city . . . etc. No one could enter or leave the country unless they had had cholera shots within the last three months . . . and this included just about everyone. Jim and I were about the only ex-

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Remarkable turnout for hamfest in Tehran at EP2GF's shack.

ceptions, having had our shots just two months earlier, so they decided to let us out if the airlines would take us.

Much to our relief we arrived in Tehran the next afternoon via Iranian Airlines. The plane was hours late, but we didn't complain. They sent over a small plane since there was just the two of us for the flight. We breathed a sigh of relief to be away from the cholera epidemic and also to be out of that blast furnace type heat. Tehran was warm, but not unbearably hot.

As soon as I checked into a hotel I called Hank EP3AM, the U.S. Ambassador to Iran, to pay my respects. I'd last talked with him on twenty shortly before leaving New Hampshire. Hank was packing to leave for a vacation the next morning so we made a date to get together that evening for a short QSO. Gerry EP2GF picked me up and took me to see Hank. We had an hour and worked over most aspects of ham radio pretty thoroughly . . . got a couple twenty meter contacts . . . and discussed the future of amateur radio in the mid-east countries.

Gerry said that the EP gang was getting together a couple nights later at his place to meet me. Why not stay at his place instead of that old hotel? OK. Jim said he would rather buzz on ahead to Afghanistan and meet me there a couple days later since he wasn't one of the DX gang anyway.

Gerry lived with a couple other fellows who worked with him at the U.S. armed forces television station in Tehran. Quite a pad too, complete with a pool and cute little Persian girls tittering around. Also one ham station which I promptly put on the air and manned during every spare hour until my departure.

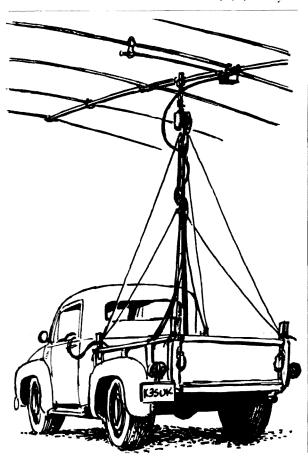
Licenses had been easy to get in Iran up until a few months ago when, suddenly, they stopped. No one knows just what the problem is or when or even if they will start issuing licenses again. There are a number of locals licensed, which speaks well for the country. Gear is hard to come by, but not impossible. Anyone seriously interested in operating can scrounge up enough to make do.

Although Damascus and Baghdad had some relatively modern parts of town, Tehran was a good deal more modern overall. Gerry took off a day and showed me the sights, including the bazaar, with its hundreds and hundreds of tiny shops strung out along tunnel-like streets. You wouldn't believe all the carpet stores they have there. And Gerry explained that these Persian carpets are more like money than carpets . . . that many of the modern people are buying American carpets when they want carpets.

About thirty of the local amateurs and their wives turned out for Gerry's party and we all had a great rag chew and feed. It was quite a hamfest.

The next morning I was on my way to Kabul and adventure in one of the most interesting countries I visited on my trip.

. . . Wayne



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Letters

Dear 73:

First I would like to tell you that it has been several years since I have picked up a copy of 73. This happened because I more or less was interested in the hobby for a while. At that time I was subscribing to QST, CQ, 73, and VHF AMATEUR. I let all of them run out except QST.

About two months ago I picked up a copy of 73 a friend had down at work. After spending several days almost reading it cover to cover I ordered the following books: Military TV, Index to Surplus, ATV-Anthology, and Parametric Amplifiers. I must say I was very impressed with the quality and material of the

books.

For the past couple of weeks now my interest has been steadily building to the point where I have now checked out a 6 meter converter, purchased a used 2 meter converter and pre amp., dusted off the old BC-312, mounted the 6&2 meter beams, and will soon be trying the Heath Kit Seneca to see if it blows up when I turn it on. I also use to work on 432 MHz but that will have to wait for a little while.

I can honestly say that all of this interest has been sparked by reading a couple recent issues of 73. The many technical articles are related to up to date circuits and modern components. There are at least a half dozen circuits I have seen in the October and December

issues that I would like to build.

Now the reason I am writing this letter is that I have a rather unusual request. I would like to start another subscription to 73 with the October 1966 issue. This is the first issue that I looked at and there are a couple of the circuits in it that I would like to build. I am afraid that I could not get a single copy away from my friend for anything. Trying to find 73s in the second hand book stores around here is a lost cause also.

So if it is not too much trouble would you please start by subscription with the October 1966 issue. If this can not be done then do the next best thing and start with the latest issue.

> M. Robert Barnett WA2EWA Rochester, New York

Dear Mr. Green:

An agreement permitting U.S. amateur radio operators to operate in India was recently concluded with the Government of India. Under the procedures established, an American amateur who wishes to operate in India should apply to do so, preferably before leaving the U.S., by writing to the Wireless Adviser to the Government of India, Department of Communications, Sardar Patel Bhavan, Sardar Square, Parliament Street, New Delhi 1, India. The writer should receive full details by return mail. You might be interested to know that several Americans are already availing them-selves of this opportunity and have received licenses to operate amateur radio stations in India.

> Donald W. Born, Second Secretary U. S. Embassy New Delhi, India

Dear Sirs:

I would like to correspond with a amateur who would like to assist a veterinarian in assembling equipment to monitor the heartbeat of an animal. I want to put a mike jack into the side of a pocket-size two-way radio that can be attached to the harness on the animal, so I can monitor it from my car, which has a receiver in it. I also need a sensitive amplifier to pick up the same on animals inside by clinic. Since I know nothing about building such, I need the expert advice of a ham interested in the field of veterinary medicine. Would appreciate hearing from anyone.

> Dr. H. Grady, D.V.M 222 Fletcher Street Thomasville, Georgin

Dear 73:

Reference is made to Bob Renfro's, WA4NXC, very interesting article in the November issue on the Air Force Eastern Test Range.

Since mention was made to the range prime and sub contractors, PAA and RCA, respectively, let us not forget another range contractor who is instrumental in up-grading the capabilities of the Eastern Test Range.

Federal Electric Corporation (ITT) is presently installing a submarine cable system for the Air Force, between Cape Kennedy and the downrange islands. The new cable will provide up to 270 4kHz channels on which telementry and tracking data, and voice messages, will be sent to the Cape in "real time."

> John J. Boucher WA2LME Manager, Quality Control FEC/AFETR Cocoa Beach, Florida

Dear 73:

I have been involved in ham radio since 1956. under my old call of K9EBC and of late WA9TJT. Operating, exclusively, VHF-UHF because it presents more challenges than any other part of the spectrum.

Today, I have received by first subscription copy of 73. The contents, as compared to other

ham magazines, are commendable.

But, gentlemen, this is the beginning of our end. Technical advancements made today and tomorrow will further transport us from technical leaders to meek followers, beginning to learn.

It all started in the days when AM was in vogue. Hamdom decided it needed something bigger, better, and newer. HAIL, the birth of S.S.B. Industry has spent billions in research, redesign, and promotion for us, only to do it

ail over again for solid state.

We, of simple hamdon, wonder what is in store for us? 1966 has come, departed, and its memory is gone with the countless millions of ham dollars. Now we are blessed with Super-colinears, 2000 watt PEP linears, Solid state (\$1500.00) receivers, Single side band, Moonbounce, Scatter, Monolithic circuits, Maser, Laser, etc. In summation I have but three questions: 1) When will ham radio, as we know it today, perish? 2) If it does not perish, when and of what wealth will it he available. whom and of what wealth will it be available to? 3) What shall we write as an Epitaph?

> James A. Kohlman, WA9TJT Chicago, Illinois

Dear 73:

RADIO NEDERLAND, the Dutch World Broadcasting System, has asked me to notify the American Amateur Radio magazines, that they will conduct a Propagation Course in their English language broadcast, starting on the first Thursday in April, 1967.

Presently, the transmitters from which this course will be broadcast, can be heard throughout the entire USA, with excellent signal strength, daily between the hours of 0130 and 0220 GMT, on a frequency of 9.59 MHz. These transmitters ar located on the islands of Bonaire, in the Dutch Antilles, just north of Venezuela.

The course will deal with many problems related to shortwave propagation, among which are:

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Printed text material and diagrams will be made available, free of charge, to anyone who plans to actively participate in the course. Full details of the wavelengths of the broadcasts and their times, will be sent to those who enroll in the course.

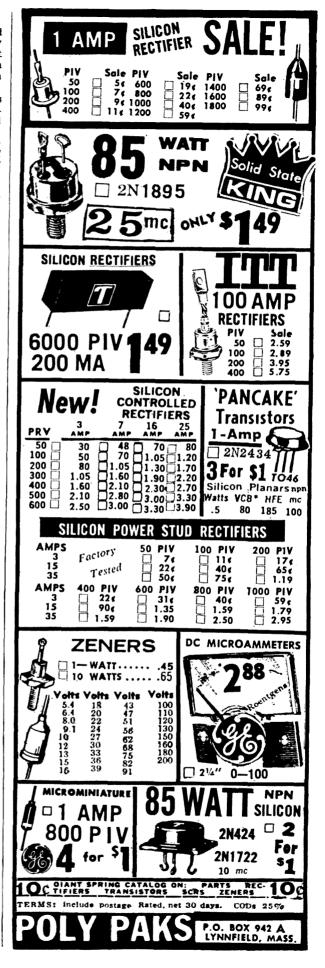
Enrollment is accomplished by writing to:

Propagation Course/ c/o Mr. H. van Gelder RADIO NEDERLAND, English Section P. O. Box 222 Hilversum, The Netherlands.



W1ICP Wins WWV Contest

WWV recently moved to Fort Collins, Colorado and sponsored a contest to publicize the move. The first person to report receiving WWV from Colorado was Lew McCoy W1ICP, Novice editor of QST. Lew called in his report within 30 seconds after the announcement of changeover. Second place went ot William Pearl, WN6UYW, of Los Angeles, and third to Willard Solfermoser, $K\phi$ DVI, of Fort Collins. Other persons who submitted confirmations will receive their QSL's in a few weeks.



New Products



49¢ FET's from Siliconix

Field effect transistors are getting cheaper and cheaper. Siliconix has just announced the E100 series of epoxy-encapsulated N-channel junction FET's for as little as 49c in 1000 quantities. They're excellent for industrial and consumer uses. Full information on the E100, E101, E102 and E103 is available from Siliconix distributors or Siliconix, 1140 West Evelyn Avenue, Sunnyvale, California 94086.



Times Coax Kit

VHF and UHF hams have known for some time that RG-8/U and other common coax is far too lossy for use in stations attempting DX or serious experimentation. However, solid-jacketed, low-loss coaxial cable has been hard to obtain in the past. Now Times Wire and Cable has introduced a kit of 50 feet of ½ inch Alumifoam coax, Timatch connectors, and complete instructions. This kit can easily be installed with no special tools, and provides far lower loss than other coax. You can get more information from Times Wire and Cable, 358 Hall Avenue, Wallingford, Conn.



Sydmur Electronic Ignition

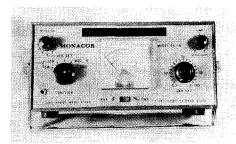
Sydmur has just announced a new transistorized capacitor discharge ignition system that is guaranteed to improve the performance of your car, and save gas, points, tune ups, and reduce ignition noise. It's made for 12 volt, negative ground systems, and sells for \$34.75 assembled, or \$24.95 in kit form, from Sydmur, Dept. 25H, Midwood Station, Brooklyn, N. Y. 11230.

Grundig Amateur Receiver

Here is a set that should make the XYL very happy: she can use it for FM, AM, SW or airport weather (LW), while the OM can use it for hamming: all-band band-spread. 160 through 10 meters, CW, AM and SSB, battery and AC operated. This is the most all-inclusive receiver we have ever seen, and no feature has been slighted, even a 1000 Hz filter. We kept a couple of SSB skeds with the TR5000 with no trouble, keeping the rf gain control at minimum. There is a connection for external antennas, tape and record input, and tape output jacks; two speakers, one a tweeter; treble and bass tone controls, FM with or without AFCthe reception was quite steady without it; built in whip antenna and ferrite loop (for AM band). The BFO, filter, AVC/MVC switches and the rf gain control are on the rear of the set, out of the way of family use of it so they won't be confused by too many knobs. The CW stability of this set is excellent-better than some ham sets we have heard, and this, of course, contributes to effective SSB reception. The tone of the audio is excellent, and is one of the reasons we think this will be a mighty popular family rig. This gem is being sold by Radio Products Sales, Inc. of 1501 South Hill Street, Los Angeles, California, 90015. . . . K1RA

17th Edition Radio Handbook

The 17th Edition of the popular Editors and Engineers Radio Handbook by Bill Orr, W6SAI, is now available. This new handbook is the latest version of one of the standards of ham radio, and contains not only the many pages of design information and reference material that all hams need, but also many new construction projects. All of the information is up to date and useful. The 17th Edition features expanded chapters on SSB gear and semiconductors. The cover is an attractive stain-resistant white, and the book is 832 pages long. Copies are available for \$12.95 from your local radio distributor or from Editors and Engineers, P.O. Box 68003, New Augusta, Indiana 46268.



The Monarch FSI-4 SWR Bridge, Modulation Meter, Power Meter and TVI Filter

This new instrument from Monarch Electronics should find a place in the shack of many hams, both old and new. Although limited to 250 watts or so, the FSI-4 is a compact unit that includes an SWR meter, modulation meter, power meter and TVI filter all in one neat package. The power limitation of 250 watts is due mainly to the components used in the TVI filter; with a cutoff frequency of 55 MHz, the components used in the filter limit the maximum power input to 250 watts up to 52 MHz. It is also usable on two meters with less than 1 dB loss, but the power input on this band must not exceed 50 watts. An additional feature of the FSI-4 is the built-in on the air indicator; this circuit is driven by an external 6.3 volt source so no power is derived from the transmitter. If you're interested in a unit that is good looking and provides several varied but important functions in the same package, write to the people at Monarch; they'll be happy to provide full specifications and tell you where you can buy it.

. . . Jim Fisk W1DTY

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GRC Recvr., C-433 and C-434/GRC Controls, AN/URR-13 and -35 Radio Recvrs., AN/ARC-27, -34, -52 Transceivers, PLUS any hi quality military or commercial TEST EQUIPMENT. We pay the most-fastest!-with a smile! CALL TODAY!

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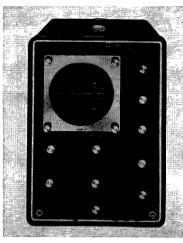
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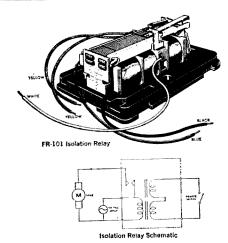
Dayton, Ohio 45403 513-252-9911



Knight KG-2100 Scope

Designed to appeal to a wide market, from the affluent big company R & D lab to the independent engineer with a limited budget, the Knight-Kit KG-2100 laboratory oscilloscope is a dc to 5-MHz triggered sweep unit with professional performance specifications. Among the special features of the 1967 model are lock-in characteristics that permit viewing stable waveform presentations even at upper frequency limits; a built-in Rotron fan for cool operation; high vertical sensitivity, 5 mv/cm, for proper servicing of transistorized equipment; 85 nanoseconds rise time; horizontal response from dc to 800 kHz triggered sweep-200 nsec/cm down to 1 sec.; regulated high and low-voltage power supplies. The dc to 5 MHz vertical amplifier response of the instrument permits the display of pulses of fast rise time. Both trigger and amplifier circuits are dc coupled throughout for uses where very low frequencies or dc levels must be displayed. Vertical off-scale indicators provide maximum convenience in viewing traces. Horizontal positioning is such that pattern is never completely off-scale left or right-even with external signals. Preset lock-in eliminates the need to synchronize sweep with inputs. Signals of various amplitudes and frequencies as small as ½ cm on the CRT face will permit triggering. Sweep range adjustable from 200 ns/cm down to .1 s/cm. Sweep timing accuracy capability within 3%. Adjustments for intensity, focus, astigmatism, positioning and graticule illumination. Color-correlated controls grouped by function for fast, accurate use. The KG-2100 oscilloscope is priced at \$249.95 in kit form, \$349.95 factory assembled. Full details available from Allied Radio Corporation, 100 N. Western, Chicago, Illinois 60680.

ALL OF OUR TRANSISTORS AND RECTIFIERS ARE GUARANTEED TO WORK! All transistors are checked for minimum voltage and gain to insure our customers a good transistor within the category we advertise. All rectifiers costing over 10¢ are checked for forward voltage and leakage as well as PRV. The gates on our SCR's are also checked. All non-operable units will be refunded or exchanged immediately. Users of the above items in larger quantities, send us your specifications. We feel we can meet them at a competitive price.	INTEGRATED SRT Flip Flops SR Clocked flip flops Expandable or gate TO-85 flat pack guarante come complete with schem acteristic sheet & some tions. \$9.00-\$15.00 valumanufacturer. We have IC's in these series avaquests. Silicon Power F	\$1.15 \$1.00 ed to work. They natic, elect, ehartypical applica- es from original other types of ailable. Send re-	GaAs VARACTORS, sim. to AP-1, AP-6, etc. 70 GHz at 150 MW. Ea
"N" Channel Fet's Similar To 2N3088 Used As Amp, Switch, Chopper— Very High Input Z \$1.50 Each SIM. to 2N1640 (PNP) Bi-directional transistors. A TO 5 silicon unit in which collector & emitter are interchangeable. Ea. \$.75 SIM. to 2N728. A high frequency TO 18 unit extending to the UHF range	100 .10	20A .80 1.35 1.90 2.45 2.85	100 MHzPNP silicon transistors\$1.50 High voltage NPN 150V. VBCBO at 2.5A. High HFE in TO-66 pack\$1.50 High voltage assemblies 3000-6000V. at 150-200 mils. These silicon assemblies may be put in series to achieve high voltages\$1.50 OUAL I MEG. POT. with off-on switch4/\$1.00 455 KHz IF XRMS Dual Slug Transistor Type3/\$1.00 262 KHz IF XRMRS Dual Slug Tube Type3/\$1.00 DUAL 20 #F at 350 V
1 T & E	E SALES	Address	Electrolytics 3/\$1.00 28-101 P CERAMIC TRIMMERS 6/\$1.00 Terms: FOB Cambridge, Mass. Send cheek or Money Order. Include Postage, Average Wt. per package ½ lb. NO COD's. Order \$3.00.



Alco Isolation Relay

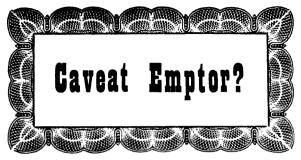
An interesting new device from Alco is an isolation relay, a combination 110 volt ac transformer and relay on a common core. It is controlled by low voltage, safe ac, yet can handle 5 amps at 110 V. Among the uses for the relay given in the instruction booklet that comes with it for \$3.85 are various remote controls, soldering iron tip saver, fire alarms, rain and burglar alarms, PTT switches, and many more. Alco Electronic Products, Lawrence, Mass. 01843.

E. F. Jol	nnson TUBE SOCKETS & Variable CAPACITORS.
122-275	5 pin jumbo, ceramic wafer, with tube clips, for 4-125A, 4-250A. NEW. \$1.25 ea. 4/\$4.75
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Sockets	for above, LESS BY-PASS & CHIMNEY, NEW. \$2.00 ea.
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WE WILL PAY CASH: Wanted, popular, late model unmodified amateur equipment. Highest prices paid for clean good operating gear. Write Graham Radio, Dept. 100, Reading, Massachusetts.

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MOTOROLA new miniature seven tube 455 kc if amplifier discriminator with circuit diagram. Complete at \$2.50 each plus postage 50c each unit. R and R Electronics, 1953 South Yellowsprings, Springfield, Ohio.

COMPLETE CONVERSION instructions for the AN/VRC-2, just \$1 while the supply lasts. 73 Magazine, Petersborough, N. H. 03458.

1963 BOUND VOLUMES OF 73. \$15 each from 73, Peterborough, N.H. 03458.

ROCHESTER, N. Y. is headquarters for Western New York Hamfest and East Coast Spring VHF Conference. Saturday, May 13. Top programming plus huge "flea" market. For more information, write: Rochester Amateur Radio Assn., P.O. Box 1388, Rochester, N.Y. 14603.

FREE CATALOG—loads of electronic bargains. R. W. Electronics, Inc., 2244 So. Michigan Avenue, Chicago, Illiniis 60616.

DAYTON HAMVENTION April 15, 1967—Dayton Amateur Radio Association's 16th annual Hamvention. Wampler Arena Center, Dayton, Ohio. Participate in the technical sessions, forums, banquet and hidden transmitter hunt. Bring XYL for best in women's activities. For information write Dayton Hamvention, Department C. Box 44, Dayton, Ohio 45401.

RTTY GEAR FOR SALE. List issued monthly. 88 or 44 mH toroids five for \$1.75 postpaid. Elliot Buchanan, W6VPC, 1067 Mandana Blvd., Oakland, California 94610.

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DUMMY LOAD 50 ohms, flat 80 thru 2 meters, coax connector, power to 1 KW, kit \$7.95 wired \$11.95 pp HAM KITS, box 175, Cranford, N.J.

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UNIQUE relay to build variety of remote controls, model railroads, liquid level control, weather detector, burglar alarm, games, trick circuits. 20 design ideas included free. 3.95 prepaid. Dept. E., Alco, Lawrence, Mass.

COAXIAL CONNECTORS. Similar to old Gen'l Radio type 774. Set consists of CBWU 49121-A plug, CANS 62112 cable adapter and CN 49120 jack. If you have any of the older model G-R test equipment, these are the connectors you need. \$1.25 each in lots of 10. Large qty avail; dealer inquiries invited. K. Y. Hoo, 3233 Conti St., New Orleans, La. 70119.

WANTED: Copies of 6-UP Magazine. Numbers 5, 6, 7 and 8 to complete personal collection. Also copies of VHFER for 1963 and 1964; April 1965 also needed. W1DTY, RFD 1, Box 138, Rindge, N.H. 03461.

TEN METER SIGNAL GENERATORS, \$5.95 each. Postpaid. Crystal controlled tone modulated. On PC board. 2 x 5 inches. Like new. Tested. Your choice in 10 kHz steps. 28.615 to 28.905 MHz. Less battery and switch. Specify frequency. Sorry, no COD. Wayne Lafayette, 5429 North Detroit St., Toledo, Ohio 43612.

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FOR SALE CHEAP: Eico 753 transceiver and 751 AC power supply. Excellent condition. Not a scratch. Jim Coulter, K8HKQ, 191 Union St., Hillsdale, Michigan.

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TOROIDS-DIODES-COAX CONNECTORS: 88 mH toroids, 45ϕ each, 5/\$2. 1000 PIV, 1 amp top-hat diodes, 55ϕ each, 2/\$1. Connectors: PL259, SO239, M359, 45ϕ each, 10/\$4. Button feedthroughs (while they last) 500 pF, 500 V 20/\\$1. Add sufficient postage. R and R Electronics, 1953 S. Yellowsprings Street, Springfield, Ohio.

VARIACS: General Radio and Ohmite. 60 cycles, input 120 V output 0-280 V at 1 amp or input 240 V, output 0-280 V at 2 amp. Pullouts in guaranteed excellent condition. \$6.95 plus postage. Shipping weight 10 lbs. R and R Electronics, 1953 S. Yellowsprings Street, Springfield, Ohio.

MOD. 15 TELETYPE machines, mod. 14 TD receivers, transmitters, power supplies, maters, voltmeters, milli-ampmeters, watt meters, variacs, plate transformers, filament transformers, Nems Clark telemetering receiver Mod. 1400 very good condition, low voltage power supplies, 300 volt regulated power supplies, 300 mills microphones, teletype converter. Alfred Michaud K1PAX, 264 East Main St., Fall River, Mass.

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WANTED: Tuning Units for R5007A/FRR502M receiver. Quote price, frequency and condition. W. E. Wolff, K5JPA, 108 Nichols St., San Marcos, Texas 78666.

MODEL, 14 typing reperforator; TD; HE-45a, matching VFO; HW-12, Hustler antenna. Best offer. Must sell to finance spring semester. K10QQ, Union College 634, Schenectady, N.Y.

HANDBOOK OF HAM RADIO CIRCUITS by W9CGA. Complete schematics and operation data on many popular ham receivers, transmitters, transceivers and power amplifiers. \$2.95 from 73 Magazine, Peterborough, N.H. 03458.

CONVERTERS, three transistor, 50-54 m in, 14-18 mc out, wired, tested, printed circuit. Crystal controlled, \$10 ppd. Tuneable, \$8 ppd. Syntelex, 39 Lucille, Dumont, N.J. 07628.

25 WORDS FOR \$2. Sell or buy through these want ads, a terrific bargain. Caveat Emptor, 73 Magazine, Peterborough, N.H. 03458.

NOVICE AND TECHNICIAN HANDBOOK by W6SAI and W6TNS. Limited quantity for only \$2.50 each. 73 Magazine, Peterborough, N.H. 03458.

FERRITE BEADS—Modern Slip-On ferromagnetic VHF chokes for Parasitic Suppression, RF Shielding, RF Decoupling and Radioferric Inductors. Dozen Beads plus Spec Sheet: \$2.00. Packaging and Postage: 25¢. AMI-TRON Associates, 12033 Otsego, North Hollywood, Calif. 91607.

NEW RTTY RECEIVING CONVERTER—A fresh new approach to frequency shift converter design gives you these features: Adjustable selectivity, 50-500 Hz. Continuously adjustable shift from 100-900 Hz. No-signal silencing. Superior adjacent signal rejection. All solid-state design. Cabinet or 19" rack mounting. \$159.50 wired and tested, \$109.95. Send card for full specifications on model BEC-900. Bird Electronics Co., 738 Pacific Street, San Luis Obispo, California 93401.

BIG GUN? BE ONE! 4-1000a's—\$39.95, 2/\$75; 4CX1000A's—\$59.95, 2/\$110. Guaranteed ICAS ratings, postpaid, insured. K6CAA, Box 435, Hanapepe, Hawaii 96716.

TRADE: HEATHKIT HW-32 and power supply HP-23 for Gonset Communicator III or IV (2 meters) or will sell for \$145.00; WB2VTP, Don Nausbaum, 167 Loines Avenue, Merrick, New York; 516-MA 3-5808.

WANTED: Tubes, transistors, lab instruments, test equipment, panel meters, military & commercial communication equipment and parts. Bernard Goldstein, Box 257 Canal Station, New York, N.Y. 10013.

WANT: R278/GR, or R278B/GR. Also R391 receivers. Thompson, 5 Palmer, Gorham, N.H.

WRL'S used gear saves money! Guarantee and trial. These low prices without trades. Thor 6 & AC \$249.95; G76 \$69.95; SR150 \$339.95; 753 \$159.95; Galaxy V \$299.95; Galaxy 300 \$169.95; DX100 \$89.95; King 500A \$184.95; Valiant \$149.95; HT37 \$239.95; HX10 \$249.95; SX101 \$159.95. Hundreds more—free list. WRL, Box 919, Council Bluffs, Iowa 51501.

SWAN-175 with SW-12 mobile supply. Very good condition. \$180 cert. check or m.o. Prepaid VIA REA. Dennis Brechlin, K9MKC, W22349 Arcadian Ave., Waukesha, Wis.

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GRAND RAPIDS AMATEUR RADIO ASSOCIATION presents their 19th annual Amateur Radio Convention Friday and Saturday, April 21-22, in the Civic Auditorium, Pantlind Hotel, Grand Rapids, Michigan. Write: G. R. A. R. A., Box 1333, Grand Rapids, Michigan 49501.

OHIO All day Saturday, April 29, the Indian Hills Radio Club will host Greater Cleveland Radio Hams and friends at the Alliance of Poles Hall, 6968 Broadway Ave. (Near Fleet and Rt. 21, Willow Freeway). This large hall will allow an all-indoor affair with ample space to sit and renew contacts with Cleveland Area Hams. Several meeting areas are available. Old fashioned good-will and sociability is the theme of the day. Donations at the door are \$1.00 and tickets to an inexpensive buffet dinner at 7:00 P.M. \$2.00. Contact John Williams K8SEV, 13231 Shaw Ave., Cleveland, Ohio 44112.

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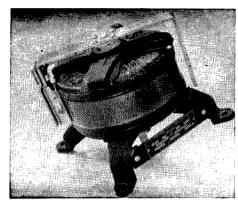
KANSAS: THE JAYHAWK AMATEUR RADIO SOCIETY announces a Hamfest and joint ARRL section Meeting to be held April 23, 1967 at Wyandotte County Park, just East of Ag. Hall of Fame, Bonner Springs, Kansas. Free hot dogs, chips, and drinks, gifts for ladies and amateurs. Registration \$1.50. Auction, swap table, YL tour, cooking demonstration, fashion show, DX, equipment displays, closed circuit TV, novice attractions, and more. Talk in 3920, 50.14 and 146.94. For more info contact K0BXF, 3045 North 72nd, Kansas City, Kansas 66109. CY 9-1128.

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MAY 1967

73 Magazine

May 1967

Vol. XLVI, No. 5

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The View from Here . . .

As the new editor of 73, I would like to tell you a little about myself. Although I've been an avid amateur since my high school days, it took an army radio school to get me across the CW hurdle to my license. Since that first license in Virginia as K4RPW, I have operated from many places, both in this country and abroad. My latest call is W1DTY, a re-tread that hasn't been seen logged since before the big war.

My electronics background in the military took me into the computer industry, but the abundance of mechanical doodads took me too far away from electronics. A stint as a technician in aerospace cured that and gave me a chance to work intimately with the newest in electronics. However, electronics again fell by the wayside when I was promoted to a papershuffling desk job.

To keep my fingers in electronics, and particularly radio communications, I began writing for 73 and teaching electronics part-time in a junior college. Finally, I wrote to Wayne about employment at 73 — I was rewarded with the opportunity to work with the staff here in Peterborough.

My ham interests are varied. There just isn't enough time to do everything I'd like to do. I like to design and build my own equipment, experiment with new VHF and UHF gadgets, work contests, and just operate in general. Right now my big kick is chasing DX on all bands from 80 through 10. Give me a shout if you hear me on, I'll be glad to chew the fat or give you a New Hampshire contact for WAS. You VHF addicts will have to wait. I put up a beam for six but a windstrom promptly removed a couple of elements, and the New Hampshire snow is not conducive to tower climbing.

In my opinion, and yours too I hope, 73 is the best ham magazine on the market. We have less trivia and more good solid technical and construction articles every month than Brands X and Y put together. If you look back through the more than 2000 arti-

cles that we have printed in the past six and a half years, you will find articles on every facet of ham radio.

I will strive to have an article of interest to each of you in every issue. Don't be miffed if we miss you one month, there aren't that many articles written on some topics.

The biggest complaint that I hear centers around late delivery. This has been a continuing problem and we hope to have it licked in a few months. Our present schedule calls for a magazine every three weeks until we get back in the groove. This is a pretty tall order for our skeleton crew, so if we only put out an issue every three and a half weeks, please bear with us—that's still progress!

In the coming months we will have articles on field effect transistors, integrated circuits, and microwaves plus features on antennas, VHF and mobile. If there is sufficient interest, we may even have an article or two on electronic bugging. If you don't see your pet project covered, let me know—better yet, submit an article. A lot of ham authors started by writing for 73. I'll give you all the help I can.

If you get up to New England on your vacation this year, make a point of putting Peterborough on your route. Although you're apt to find the office deserted on the weekends, there's someone here from Monday through Friday. We're not hard to find either, just look for the towers. The very least we'll do is give you a guided tour, introduce you to the staff and try to sell you a life subscription.

If you can't make it to Peterborough, look for me at the conventions and hamfests. Time doesn't allow me to make all of them, but I'll try to get to as many as I can. If you don't find me wandering among the exhibitor's booths or at one of the technical sessions, try the snack bar. I've been known to buy a round of coffee.

Jim, W1DTY

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de W2NSD|1 Never Say Die

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Thousands of amateurs govern their work and their very lives by the movements of DXpeditions. When Gus was scheduled to be on from some rare spot thousands of desks were empty until the contact was made. The DXers are keen and dedicated. You really couldn't ask for more in involvement.

Other thousands of amateurs and equally involved in traffic handling and the traffic nets. Others are hung up on ham-RTTY or ham-TV. Others devote years to a moment or so on moonbounce. Tremendous dedication . . . involvement.

This is good, I think.

One whole big segment of the ham population is almost impossible to lure outside the workshop. They're building things. They don't want to operate . . . to send messages . . . a lot of the time they don't even want to go to dinner or bed. Involvement.

Great!

A few fellows are all whipped up in the politics of ham radio. Some run for ARRL offices and are deeply involved in the League and its workings. Others are generating tremendous quantities of sweat over the Certificate Hunter's Club, the Amateur Radio Editor's Association, and the like.

But ham radio is not DXing, or traffic handling, or the ARRL, QSL'ing, AREA, or building gear. Ham radio is all of these put together, plus all other facets of our hobby. It is the total. And here is where we most desperately need involvement. Each aspect of our hobby has plenty of support, but the lack of fellows interested in the future of the total may be our undoing.

Is there anything that can be done about this? Ham radio is in reality not one hobby, but a whole group of hobbies and it takes an unreconstructed idealist to fight for something that he personally isn't particularly interested in. You don't see many DXers in there battling for reason on the splitting of the two meter band. The traffic men couldn't care less about what is or is not a new country. And so it goes . . . with the result that there is, essentially, no individual ama-

(Turn to page 111)

The Quad-Quad-Quad

Sixteen three-element quads for two or sixteen nine-element quads for 432 provide a very impressive antenna and signal.

What in devil is a quad-quad-quad? For that matter, what is a quad?

There are two common uses for the word "quad" as applied to antennas. When we put up four antennas in a square formation, we say that we have a quad of antennas. We may have, for example, a quad of 10 element yagis, for a total of 40 elements. The other use of the word applies to quad elements. A quad element is a square of wire, or tubing, which usually has a perimeter of 1 wavelength.

If you make four yagis with quad elements and mount them in a square formation, you have a quad of quads, or a quadquad. Doug DeMaw described such an antenna in the May 1964 issue of 73. If you put up four quad-quads in a box formation, you have a quad of quad-quads, or a quad-quad-quad. Such a monster is the subject of this article.

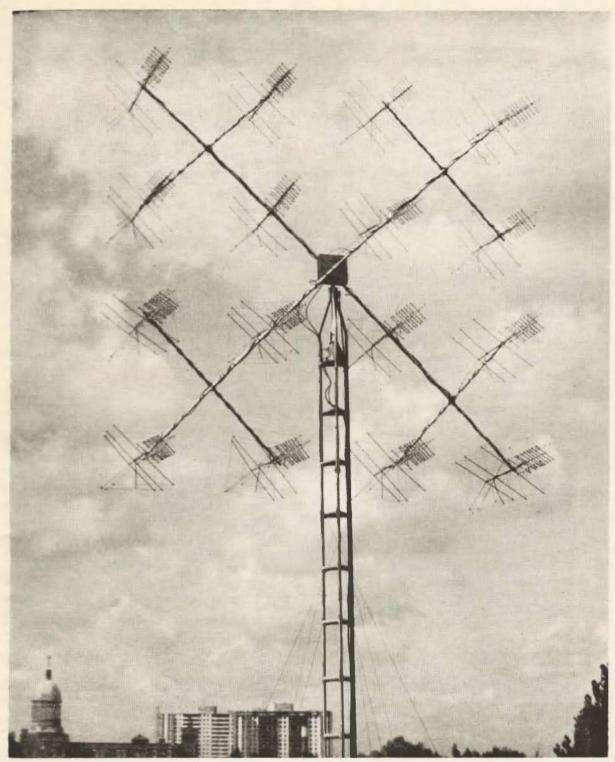
In the summer of 1964, I had the booms drilled and the elements cut for four 8-element yagis. Just before buying the tubing to mount the yagis, I overheard Russ, K2KGN, extolling the virtues of his quadquad, on 2 M. A bit of calculation revealed that it would cost less to start again from scratch and build a quad-quad, than to finish the yagis. The fact that no one else had a quad-quad in Metropolitan Toronto

settled the matter. You can't do better than your buddies if you do what they are doing.

In making the quad-quad, my first mistake was the use of aluminum clothesline wire. It sure is nasty stuff to solder. My second mistake was the use of open wire feeders. Open wire is nice if you can keep the wires parallel and you live where there is no rain or snow.

In spite of its deficiencies, the antenna performed fairly well, when the feeders were not shorted.

The advantages of the antenna are low cost and small size for the gain achieved. The elements have gain over straight dipoles, because they are really two half waves spaced a quarter wave apart. This allows you to use shorter booms for a given gain. With three elements, the boom is so short that you can support the boom behind the reflector. This keeps the supporting structure out of the antenna's field, which is always good. It also allows you to mount half of the array below the top of the tower. since the tower will be behind the reflectors. With the center of the array right at the top of the tower, there is no need for a long strong mast to carry the whole weight of the array in a strong wind. Only 2 inches of my mast is between the tower and the bottom of the mounting plates at the center of the array.



The quad-quad-quad array at VE3DNR. This antenna has sixteen three-element quads on two meters and sixteen nine-element quads on 432 MHz.

Designing the beast

After I had the quad-quad up, Russ, K2KGN, put another bug in my brain. How

about 16 quads? At first it seemed almost impossible for me. After months of thought, during the winter of 1964-1965, the difficulties disappeared one by one. Measure-

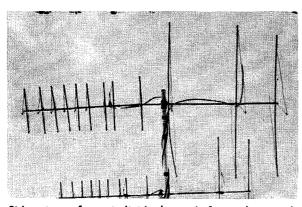
ments and construction were done during the summers of 1965 and 1966.

When you start thinking about a quadquad-quad, you soon realize that the spacing between yagis will be small, or the beast will be awfully big. A little more thought, with much calculation, reveals that this beast could also be awfully heavy. One of my early designs had a calculated weight of 120 pounds.

You must fight excessive weight as you would when building an aircraft. You would be surprised at the weight of such things as coax. The final design has a calculated weight of 54.4 pounds, including the mast and mounting plates. It is so light that I can lift it by the mast and remove the rotor, which is mounted inside the tower. The mast rotates in a collar at the top of the tower, so it is not necessary to hold it from going sideways.

I wanted to avoid mounting the booms cantilever style, but I still wanted to have the supports behind the reflectors. The solution was to extend the boom on the back side of the supporting tubing, and to put some sort of counter weight on that end. A nine-element quad for 432 MHz has the same weight as a three element quad for 144 MHz. So it was decided to put a 144 quad on one end of each boom and a 432 quad on the other end. The result would be sixteen 3-element quads for 144 and sixteen 9-element quads for 432.

The result had to be as small as possible, so it was necessary to redesign the quads to reduce the size. On the 144 quads, I found that I could bring the reflectors within 14" of the driven element without chang-



Side view of an individual quad from the quadquad-quad array. The nine-element 432 quad is on the left; the three element 2 meter quad on the right.

ing the gain appreciably. The reflector length was tuned for the minimum received signal off the back. The director was not at all critical. As near as I could measure it, the gain of one quad was 8 to 10 dB over a dipole. The front-to-back ratio was about 14 dB and there is a null off the side, as is usual with quad elements.

The design was actually done at 145 MHz, to cover 144 MHz to 145.5 MHz. Antennas usually cover more megahertz below the design frequency than above. When I refer to the 144 quads, I mean the ones designed for the 2 M band, not just 144 MHz.

With the 432 quad directors, I used the idea of a slow wave structure consisting of five equal elements with matching elements at each end. This was described by Loren, K7AAD, in the May 1965 issue of the VHFER. The 432 quads had measured gains of 14 to 15.5 dB.

Measurement

The measurements on the individual quads were performed indoors. Many will look with disdain on such an idea. The main dangers would seem to be the reflections from the surroundings and the effect of the surroundings on the impedance. It was necessary for me to put my hands very near to the quads in order to change their gain. I also observed deep nulls, which would tend to indicate that the reflections were not very serious. The room was not typical. It was a second floor, unfurnished, room with non-metalic insulation.

One advantage of the quad is that it is only a quarter wave wide. Therefore, it does not come as close to obstructions as would an antenna with ordinary dipoles. This would make indoor measurements more feasible with the quad than with the yagi with straight elements.

Measurements were made using the quad as a receiving antenna. A signal generator was connected to a dipole and a superregenerative receiver was connected to the quad, through 100 feet of RG-58/U cable. There was about 15 feet between the two antennas.

The idea of using a super-regen was to get a sensitive indication of when there was a change in signal. With a large signal present, the super-regen is very insensitive to changes in signal levels. On the other

hand, at the receiver's threshold, very small changes in signal can be detected. So the attenuator on the signal generator was varied so that the signal could barely be detected in the receiver. This gave a sensitive indication of when the quad was made better or worse.

The idea of using cheap and dirty RG-58/U for measurements also comes from Loren, K7AAD, in the May 1965 issue of the VHFER. Tuning an antenna for the best SWR does only part of the job. A dummy load gives a fine SWR, but it makes a lousy antenna. What we want is the maximum signal in a 50 ohm load attached to the antenna, in the receiving case. A lossy piece of coax gives its characteristic impedance at one end, no matter what is at the other end. So 100 feet of RG-58/U at 145 MHz will show approximately 50 ohms to our quad, no matter how lousy the receiver's input impedance is.

When we have adjusted our antenna for the maximum received energy, there is no more that we can do. SWR or no SWR, our antenna is putting out as much signal into a 50 ohm load as it can. So, I don't know what the SWR of this antenna is, and I don't care. I have done the best I can.

Characteristics Of quads

There are several features of the quad which should be noted. The square quad, with sides at the top and bottom, works better than the diamond quad, with corners at the top and bottom. The difference is not large, but it is measurable.

As shown on Fig. 1, a current maximum will be wherever you feed the quad. Since the quad is 1 wavelength around, the opposite side will have the other current maximum. This puts the current minima, and the voltage maxima, half-way between. With a square quad, the voltage maxima are in the centers of the vertical sides. With the diamond, the voltage maxima are at the side corners. Since it is convenient to have the spreaders supporting the corners, the diamond has supports at its voltage maxima. Unless these supports are high quality insulators, and therefore expensive, you lose quite a bit of power in the supports. The square quad has its supports away from the voltage maxima, and is therefore more efficient.

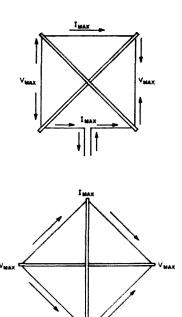


Fig. 1. The current and voltage maximums in square and diamond quads. The square quad is slightly more efficient that the diamond version because the supports are away from the voltage maximums.

For reasons which are a mystery to me, it seems better to solder the directors and reflectors at the current maxima. The opposite seems more logical to me, but my measurements clearly indicated this fact. Horizontally polarized quads should have their directors and reflectors soldered at the top or bottom.

The quad seems to be fairly sensitive to polarization. Rotating the quad on the axis of its boom by 90° produces a large change in the signal received. This is reasonable because the vertical sides of a quad, fed at the top or bottom, have currents flowing in both directions. This would cancel the vertically polarized signal.

The quad seems to be quite happy with unbalanced feeders. Measurements were made with a 432 quad fed with 50 ohm coax straight and with a 1/1 balun. The difference could not be measured. I was quite happy to save the weight of the baluns.

I can guess at the reason. With an ordinary dipole, the side connected to the braid of the coax is connected only to ground. It may get some signal from the other half, but it is operating at a disadvantage. With a quad, all of the element is connected to

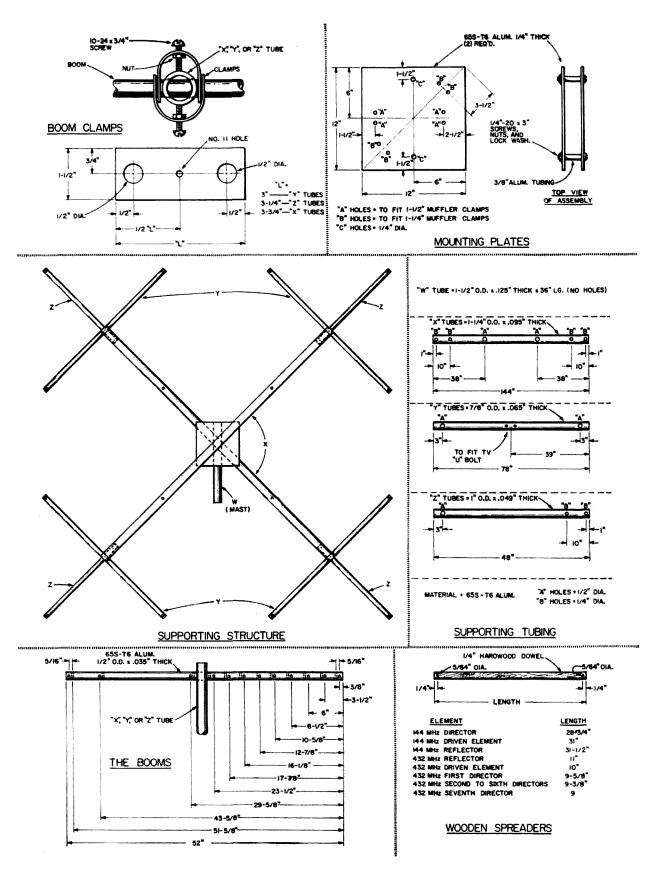


Fig. 2. Constructional details of the quad-quad-quad. The type of construction shown here results in a very strong unit that only weighs about 55 pounds.

the inner conductor, since the element is one piece of wire. It would seem that the quad element would be happier operating as an unbalanced antenna than would an ordinary dipole.

I see no reason to believe that there will be less fading with a large antenna. Although it is true that a signal will be received even if one quad is receiving nothing, it is also true that all the quads could be receiving something, but they could cancel each other. To me, one QSB situation seems as likely as the other.

If you want diversity reception, you must feed the signals from more than one antenna to more than one receiver, and add the audio signals. Only at audio frequencies can you keep the signals from the various antennas in phase. The 16 quads would seem to be good for a four channel diversity system. You could have the four quad-quads polarized horizontally, vertically and at the two 45° angles.

Construction

To save weight, the elements were made of #14 wire instead of the #10 used by Doug DeMaw. This may account for his superior front-to-back ratio. #10 wire for only the reflectors, which seem to be the most critical elements, may be a good idea. The spreaders were made of ¼" dowel instead of ¾".

The position of the holes in the booms are specified by Fig 2. The booms were drilled with %" holes so that the spreaders could be passed through the booms. This saves the weight of the circular hubs that Doug used. The booms are very thin. There is danger that you will bend the booms where the holes are drilled. I bent one while installing the antenna. Since an individual quad is light, it can't do much damage if it falls. Therefore, we can take the chance that we have made the booms too thin.

It looks much better if you can make the holes in the boom line up; it looks less of a mess to the neighbors if the elements are in a line. A drill press is handy, but you can do a fair job with an ordinary electric drill. I doubt that perfect alignment will improve the electrical properties of the antenna.

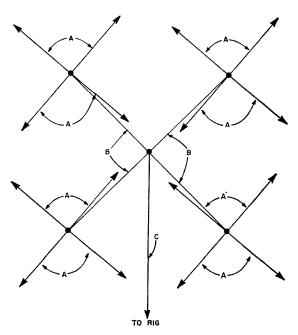
The size of the elements have been given by specifying the lengths of the spreaders in Fig. 2. If the wire is under a bit of tension,

you will come very close to getting the right perimeter every time. Even if the wire does not form a perfect square, the perimeter comes out roughly the same if the spreaders are the right lenght. The dimensions are not very critical. If you try to make the distance between the holes on the spreaders accurate, you should have more than enough accuracy.

Before putting the spreaders through the boom, you will find that you must file the holes in the booms. If you file the hole only enough to get the spreader in, you will need no adhesive to keep the spreader centered in the hole. It is easier on the nerves if the spreader stays put while you are trying to put the wire in place.

The booms are put through ½" holes in the supporting tubing. Therefore, you can only wire the quad on one end of the boom before putting the boom in the ½" hole. Since the 432-MHz quads have three times as many elements as the 144-MHz quads, you will naturally make the 432 quads first. You want to string as many elements as possible before getting the booms involved with the supporting tubing.

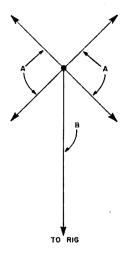
The ends of the spreaders were painted



CABLE "A" = SMALL 50 ... CABLE (TIMES MT5-50) | 1 \(\) (64-7/8") AT 145 MHz 5/2 \(\) (54-1/2") AT 432 MHz CABLE "B" = SMALL 50 ... CABLE (TIMES MT5-50) | 5/4 \(\) \(\) (81") AT 145 MHz 15/4 \(\) (81-3/4") AT 432 MHz

CABLE "C" . LARGE 50 A CABLE (TIMES MT4-50)

Fig. 3. Cable assembly required for feeding the quad-quad-quad; all the sections of the cable assembly are made from low-loss 50 ohm coaxial line.



CABLE "A" - SMALL 100 .t. CABLE (RG-62A/U) 5/4 \(\lambda\) (85-1/2") AT 145 MHz 13/4 \(\lambda\) (74-5/8") AT 432 MHz

CABLE "B" - LARGE 50 A CABLE (TIMES MT4-50) ANY LENGTH

Fig. 4. Cable assembly for feeding a four quad quad-quad; this assembly uses both 100 ohm and 50 ohm coaxial line to obtain the proper impedance transformation to the main 50 ohm coaxial line.

with General Cement's Liquid Tape to cover the holes where the wire goes through. Then the whole spreader was painted with marine spar varnish.

The means of holding the booms in the ½" holes is one of the standard methods. The clamps are described by Fig. 2. Probably only one clamp per boom is necessary, but they are light and one clamp seemed marginal to me. Of course, you could weld the booms in place, if you know that you will never want to take it apart. Surely you will want to build something bigger in future.

The supporting structure was put in the form of a X frame. (Fig. 2) instead of the more usual H frame. This arrangement was used because it seemed lighter for a given strength. My only regret is that it would have been easier to tilt the H frame for moonbounce. Since I don't have the equipment for moonbounce activities, this doesn't bother me much.

The mounting plates (Fig. 2) are clamped to opposite sides of the mast (W) with 1½" muffler clamps. The 1¾" tubes (X) are clamped to the plates with 1¾" muffler clamps. To add strength to the assembly, ¾" aluminum tubes are wedged between the two plates, as shown in Fig. 2. These tubes are held in place by ¾" screws which go through both plates and the ¾" tubes. With this arrangement, each plate helps to

keep the other plate from rotating around the mast in a wind. I can't tell you what holes to drill for the muffler clamps because your clamps will probably be different from mine.

The Z tubes fit inside the X tubes and 2" from the ends of the X tubes, using TV "U" bolts. Since you probably will use different "U" bolts from mine, I can't tell you what holes to drill in the Y tubes. The Y tubes are bolted to the same side of the X tube as its mounting plate. This makes it easier to line up the quads.

The Z tubes fit inside the Xtubes and are fastened with \(\frac{1}{2}\)—20 screws, 1\(\frac{1}{2}\)" long. The holes in all the supporting tubes are specified by Fig. 2.

Since the X tubes are separated by the plates and the mast, we must compensate for the space between them. All of the quads must line up as close as possible so that they are all the same distance from the other fellow's station. Otherwise, the signals from the 16 quads will not add in phase. This is, of course, more critical at 432 MHz than at 144 MHz.

The booms in the X and Z tubes are pushed toward the center of the array as much as possible. By the center of the array. I mean a line drawn parallel to the X tubes which passes through the mast. The booms in the Y tubes are pushed (in my case) 3" away from the centers of the booms in the direction of the center of the array. The exact distance depends on the dimensions of your muffler clamps. This should make the quads line up to within ½" or so. You must also be careful that the Y tubes are clamped to the X tubes properly to make the quads line up. Finally, when clamping the X tubes to the plates you must rotate the X tubes so that the quads line up.

All of the muffler clamps and "U" bolts must be protected to prevent rust. I used Vaseline, because it is readily available and it has always done the job for me.

The cable harness

The coax connecting the quads together is small, RG-58/U size, cable. Naturally, the larger, RG-8/U size, cable would have lower losses, but more weight. Since the length of the cable from the common junction to any quad is short, the losses in small cable should be small. The additional

weight of large cable seemed intolerable. Below the common junction, the weight of the cable is supported by the tower and we can therefore use large cable for the

long run to the rig.

Fig. 3 shows the cable lengths for 16 quads. Each quad is designed to have an impedance of 50 ohms. So when four guads are connected together by 50 ohm cable, we have 50/4 ohms as the total impedance at these junctions. Each of these four junctions is connected to the common junction by 50 ohm cable which is an odd number of quarter waves long. These quarter wave sections transform the 50/4 ohms to 4×50 ohms. The main junction sees four 4 x 50 ohm impedances connected in parallel to give 50 ohms. The main cable to the rig is 50 ohms, so it is matched.

The cable used was made by Times Wire & Cable and distributed by Mosley. Any other cable could, naturally, be used if the velocity of propagation is taken into account. The dimensions in inches on Fig. 3 are for the Times cable. The distance in wavelengths required is, naturally, the same

for all types of cables.

For a four quad array, 100 ohm cable could be used, as in Fig. 4. An odd number of quarter waves would transform the 50 ohms of each quad (100/2) to 2 x 100 ohms. Four cables connected together would give \(\frac{1}{4} \) of 2 x 100 ohms or 50 ohms, to match the cable to the rig. The most appropriate cable I can find in the catalogues for the quarter wave sections is RG-62A/U; its impedance is 93 ohms instead of 100 ohms.

You may raise your eyebrows at the idea of connecting the cables without coax connectors. If you count the number of connectors that would be needed for the 16 quads on two bands, you can see the point of avoiding connectors. The weight, let alone the cost, of all those connectors is prohibitive. Therefore, we must do our best at making reasonable coaxial connections with

trusty soldering iron.

The five cables for each connection were laid out like five spokes of a wheel, as shown by Fig. 5. The inner conductors were soldered and the joint was insulated with tape. The outer braids were then folded over the tape to cover each side of the joint. The braids were then soldered together to form a solid shield all around the connection. The joint is fairly strong



(A) SOLDER THE INNER CONDUCTORS AND TAPE CONNECTION



(B) FOLD THE BRAID OVER, SOLDER, AND TAPE AGAIN

Fig. 5. Connecting the coaxial cables together without using connectors. The coaxial connectors required for the quad-quad are very expensive and add a lot of weight at the top of the tower.

after the braids are soldered. The finished connection is then taped and coated with some weather-proof material. I wouldn't recommend the coating that I used, so there is not much point in naming it.

Of course, you must be careful to connect all the quads in phase. All of the inner conductors must go to one side of the quads (eg. the right sides) and the braids to the other sides (eg. the left sides). If you goof on ½ of the quads, you will have a nice null where the main lobe of the pattern should be. These connections should be coated with something weather-proof.

The cables run up from the driven elements to the booms, along the booms and then along the supporting tubes. The cable is wound around the tubes and taped. The lengths of cable specified include enough slack to route the cable in the same way.

Getting it up

To show that it is possible, I decided to put up the beast alone. Unfortunately, my refusals of offers of help may have rubbed a few relatives, hams and neighbors the wrong way. It seemed important to show

that anyone out in the sticks could do the job without help.

The key to success is to have a gin pole, which is a piece of pipe with a pulley on one end. You bolt the pole to whatever is already in the air, with the pulley at the top. Then you pull up whatever is next with a rope running over the pulley. My pole is 12 feet of 1¼" aluminum tubing, with a clothesline divider bolted to one end with a "U" bolt.

The antenna was put up in three sections. The mast and plates were put up first. Then each X tube was put up with all the stuff that each one supports. The two main junctions of the coax (one for each band) were soldered with the antenna in place.

It isn't really easy to do the job yourself, but it is possible.

Performance

The antenna moves in two major directions in a breeze. As you would expect, there is a strong tendency to rotate about the axis of the mast. Since the rotor is of the TV type, it is not strong enough to keep this rotation under control. There is a clamp at the top of the tower, which allows me to lock the mast to the tower. This clamp can be controlled from the ground using a "rope and pulley" system. The system works, but I hope to replace it with some electro-mechanical system that can be controlled from inside the shack. A heavy duty rotor would cost 4% times as much and it still would not hold the antenna as well as my clamp. I have seen the way that some expensive rotors hold big ham antennas in Toronto and they impress me very unfavorably.

The other motion is rotation around the axis of the 1½" tubing. This motion is not too severe because it is limited by how far the X tubes will twist. This motion shows that tube Y must be clamped firmly to tube X. Plenty of wind force is available to twist tube Y around the axis of the X tube. Perhaps, in my next model, I will put braces between the X tubes and the Y tubes.

The electrical performance is difficult to state definitely. This antenna is the first one at this QTH which was made at all properly. There is no well made antenna at the same height that I can use for comparison.

Comparing my results with others is also not valid. My QTH is not at all average. The 60-foot tower for the antenna sits on land 300 feet above and 1000 feet horizontally from Lake Ontario. The QTH is in Scarborough, the eastern borough of Metropolitan Toronto. To the west, my signal must fight its way across 18 miles of city and climb the Niagara escarpment, 30 miles away, before getting anywhere. To the east, there is smooth sailing over the lake for 150 miles. My coverage very much depends on the direction.

For what it is worth, I can hear W8KAY, Akron, comfortably out of the noise when his beam is on K2IEG. With the four quads, he was just audible. I have gained the ability to work the weaker boys (AM) around Rochester, N. Y. and the tower types in downtown Hamilton. On two occasions I have worked dx stations to the west and south immediately after Dennis, VE3ASO, worked them. They reported that my signal was 2 S points better than Dennis's. VE3ASO has 150 watts and 40 elements in a reasonably good suburban location in western Toronto. I have 60 watts.

I have no 432-MHz gear yet, so I can't report on the performance of the 432 quads in actual operation.

Conclusion

The quad can serve all types of two meter hams. Those who have little in funds and space can make one quad. It will fit, and rotate, in the attic or sit in the corner of the apartment balcony. Tell the landlord that it is a work of modern art, which it will be if you do a good job.

The average Joe can put up four quads without stretching the budget much; it should do as well as about 24 ordinary elements in far less space.

The ambitious can put up 16 quads, which might be enough for moonbounce. The 48 quad elements should do as well as 96 ordinary elements. OH1NL had only 24 elements in front of a screen to work W6NDG. You can also use the antenna for earth-bound contacts, because it is small enough to put on a tower. A large parabola on a high tower presents nasty mechanical problems because of the wind.

Why use straight elements, when you can get more gain with quads? Give them a try.
. . . VE3DNR

The Expanded Quad

This article describes an experimental expanded quad which is practical to construct and which has considerably more gain and directivity than an ordinary quad of equal elements. A three-element version was constructed which works excellently on 10, 15, 20 and 40 meters.

The antenna originated in an attempt to construct the expanded (XQ) two-wavelength quad described by William I. Orr, W6SAI in his book on "Quad Antennas'. This book should be read by anyone who plans to construct a quad antenna. Orr developed the "XQ" quad from the "Lazy H". It had a side length of ½ wavelength and the three-element version was estimated to have more than 10 db gain over a dipole.

Originally a 3-element, 3-band quad was constructed in which the 10 and 15 meter elements were the XQ 2-wavelength loops. The 20 meter elements were conventional 1.0-wavelength loops. The 15 meter elements were loaded with coils to reduce the size, but they were still larger than the 20 meter ones.

After considerable experimentation, the

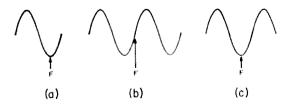


Fig. I. Feedpoints in the current wave for (a), an ordinary I wavelength quad, (b), a 2 wavelength quad, and (c), the I.5 wavelength expanded quad.

2-wavelength XQ was given up because of structural weakness and because the high impedance (2,000-3,000 ohms) at the feed point made matching too difficult.

During the experimenting it was noticed that the 10 meter XQ had a strong resonance and low impedance at a frequency near the 15 meter band. A check showed that the antenna was 1½ wavelengths at this frequency, and the feed point at the center of the bottom side had an impedance close to 50 ohms.

With the belief that this 1½ wavelength loop would approach the high performance predicted by Orr for the 2-wavelength XQ, the antenna was reconstructed to have 3-element, 1½ wavelength loops for 10 and 15 meters and the 20 meter was left as the standard quad.

All three bands have been satisfactorily matched to a single 52 ohm RGSU coaxial feed line. However, matching would have been simplified and the interaction less if a separate line had been used for the 15 meter antenna.

Numerous contacts and comparative tests have proven the 10 and 15 meter 1½ XQ's to be very effective. In over 90% of the contacts the S-meter rating received was better than could be given to the contact even though many of them used kilowatt linears in comparison to the 300 watts of the TR3.

Don is a professor at Texas A and M university (Phd Chemical Engineering, Iowa State). He has operated as HC2WH in Quayaquil, Ecuador.

The directivity, front to side and front to back ratios are noticeably better than those of the 20 meter quad which was used for comparison. It is believed that the gain of the 1% XQ is close to that esti-

mated by Orr for the 2λ XO.

An added bonus is that the 15 meter 1% antenna works very well as a 1/2 folded beam for 40 meters. This was observed after the antenna was erected so no attempt has been made to match it for better SWR or front to back ratio. As it is the SWR is 2.5 at 7.3 mc. and 1.05 at 7.2 mc. The element spacing constructed for 15 meters is much too close for 40 meters and a compromise should be made for more emphasis on the latter band.

Since the 1% XQ has performed so well on 10 and 15 meters, a 20 meter version has been planned. In the existing antenna, the spacing between the 15 and 20 meter wires is about 8 inches and there is considerable interaction when using a common feed line. With the 11/2 XQ for both 15 and 20 meters the spacing will be 3½ feet and the interaction should be greatly reduced.

With existing quad antennas, the 10 and 15 meter elements can be readily converted to the 1½ XQ for improvement in DX operation.

The 20 meter 11/2 XQ requires a side of 25 feet and spreaders 18% feet long. However, this is conservative when compared with some of the beams having 50 ft. booms and weighing 150 lbs. or more. A full size 40 meter quad at W3APO has 25 ft. fiberglass spreaders.

Theory

The reader is again referred to the book on Quad Antennas or the Antenna Handbook for the theory of the XQ and the detailed discussions of quads. Fig. 1 shows the feed-points in the current wave for (a) an ordinary 1.0λ quad, (b) a 2.0λ XQ and (c) the 1.5λ XQ, when the feed is at the center of the bottom side. The impedance of the quad and the 1.5\(\lambda\) XQ is usually between 40 and 75 ohms, while the 2.0x XQ will be in the enighborhood of 2,000-3,000 ohms. A % wave matching section may be used to reduce the high impedance to that of the line.

Tne ends of the quad are in phase and can be electrically joined, but the 1½ XQ

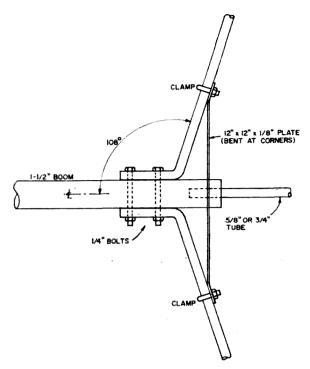


Fig. 2. Attaching the spreaders to the boom.

antenna ends are out of phase and must be separated by an insulation.

The 15 meter antenna works on 40 meters since 21 MHz is a third harmonic of 7.0 MHz. Actually if the antenna resonates at 21.4 MHz at 11/2 wavelengths it will resonate at 7.14 MHz as a 1/2 wavelength antenna. Experience has shown that the tuning is broad enough to cover the whole 40 meter

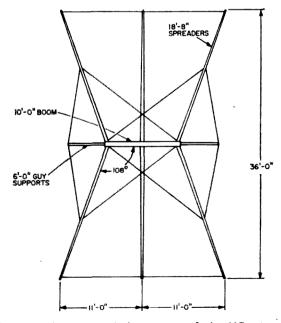


Fig. 3. Side view and dimensions of the XQ.

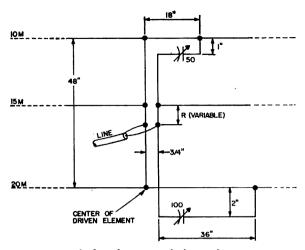


Fig. 4. Match for the expanded quad.

Construction

A construction description will be given for the 3-element, 3-band 1½ XQ antenna. Since it also works on 40 meters, it is actually a 4-bander.

Although a 4-element antenna of this type would give a slightly better performance, it is doubtful if the additional cost, labor, and wind risk is justified. On the other hand a 2-element version would be easier to construct and should have a gain better than 7 dB on all bands except the 40 meter band which would have a gain of 4 or 5 dB over a dipole.

No. 14 solid enameled copper wire is used for the antenna and a little over 8 lbs. is required. The loop sizes are as follows:

Frequency	Director	Driver	Reflector*
14.3	96'	100'	100'
21.4	64'3"	67′	67'
29.0	47'6"	49′6″	49'6"

*Reflectors are kept the same size as the driven elements to minimize spreader length. Either stubs or coils may be used for tuning.

Spreaders

The four front spreaders should be 17'9", the center ones 17' 9", and the back ones 18'8" long. They should be fairly stiff because of their length and preferably made of fiberglass-plastics. Since it is difficult to find bamboo this long, a combination of 1½" or 2" O.D. aluminum tubing and bamboo may be used. The bamboo should be covered with fiberglass plastic or it may be coated with butyl-aluminum roofing paint. Measurements indicated that the aluminum

paint had no electrical significance.

Boom

A ten foot length of galvanized steel or aluminum electrical conduit is suggested. This should be 1¼" or 1½" nominal pipe size or a 2" O.D. stiff aluminum tube could be used. The boom is extended at each end with 6 foot lengths of ¾" or ¾" O.D. light-weight tubing to serve as terminals for attaching the cross-bracing cards.

Assembly

Assembly of this antenna is quite an engineering feat. It was found convenient to attach the boom to a tilting mast in such a way as to permit rotation for access to the spreaders. The spreaders may be attached to the boom with purchased spiders. However, the author used sections of aluminum tubing as part of the spreaders and these were flattened and bolted to the boom as shown in Fig. 2. One foot square stiff aluminum plates were used for bracing.

Fig. 3 shows a section through the boom and center element. This is a diagonal section extending to opposite corners of the quad. Cross bracing with 150 lb. test nylon cord is used to increase strength and the ends of the spreaders are connected with it to hold the proper spacing. For clarity wiring is not shown on the figure.

Adjusting for frequency

Before attaching the connecting network each element was adjusted for proper frequency with a grid dip meter. The exact frequency was obtained by picking up the signal on a receiver. The driver elements were adjusted to 14.3 MHz, 21.4 MHz, and 29.0 MHz. The directors were adjusted to 14.9 MHz, 22.4 MHz and 30.3 MHz. Small tuning coils 2½" diameter, and having a length of wire of about 4% of the element, were used to adjust the reflector frequencies to 13.6 MHz, 20.4 MHz, and 28.0 MHz. Tuning stubs could be used if preferred.

Connecting to the feed line

A single RG8U, 52 ohm, feed line was used and this was connected to the three antennas as shown in Fig. 4. The 48" long header was constructed of No. 12 stiff copper wire and spaced ¾" with micarta in-

sulators. Gamma match connections were made to the 10 and 20 meter antennas and a direct connection was made to the 15 meter antenna. The line was connected to the header about 8" below the 15 meter antenna and the distance was varied to serve as a means for tuning.

The gamma match lengths and capacitances are approximate and are varied to obtain the best match. The values are affected by element spacing, proximity of the band loops, and height above ground.

Temporary variable condensers were used in the gamma matches. When tuning was complete they were replaced by short lengths of RG58U coax experimentally cut to give the same match. These were then sealed to keep out moisture.

Although the SWR is the final test, it is desirable to use an antennascope or impedance meter to make the matching adjustments. The antennascope construction is described in the "Radio Handbook" published by Editors and Engineers.

The method used for matching the 15 meter antenna to the line was made necessary by the interaction between it and the 20 meter quad antenna. With 1½ XQ

should be easier.

Since the gamma match lengths, capacitances, and the feed point are all interacting variables, considerable adjusting is needed to obtain a low SWR for all bands. However, the gamma lengths are not very critical and the 10 meter adjustments are almost independent of the 15 and 20 meter settings. So, after a preliminary adjustment of the capacitor on the 10 meter gamma, an optimization of the 20 meter capacitance and the feed-point setting (R) will bring the system to a fairly close balance.

The final SWR readings after the antenna was raised to 40 feet are shown below. These could have been improved by tuning with the antenna further from the ground.

Freq. 7.3 7.2 14.4 14.2 21.45 21.3 28.5 29.0 SWR 2.5 1.05 1.3 1.75 1.1 1.8 1.6 1.2

The results obtained from this antenna have repaid the trials and tribulations of building it. This includes repair after a windstorm blew it into the trees and a broken arm caused by a rotten ladder breaking under me.

. . . WA5KXY

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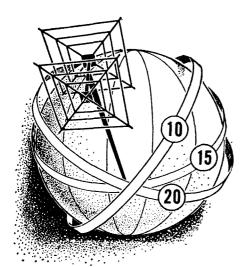
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An Inexpensive DX Antenna

Howard Krawetz WA6WUI 654 Barnsley Way Sunnyvale, Calif.

The increased activity in our ham bands has forced many good amateurs to use high gain directional antennas to obtain good solid contacts. The cubical quad antenna described here is quite directional, has high gain, and is inexpensive when compared to other beams (total cost is about \$30).

The antenna is mounted with spreaders running horizontally and vertically rather then diagonally. This enables the metal spider brackets to be welded with greater ease and may also add some strength to the assembly. The spider brackets should be made of %" x ½" x 2' aluminum angle (4 each required). Weld each pair on centers and at right angles. The spider to boom bracket

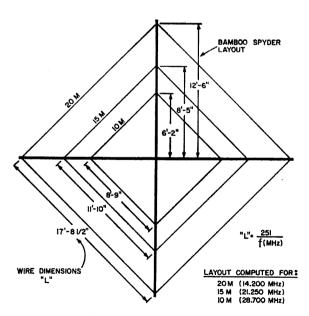
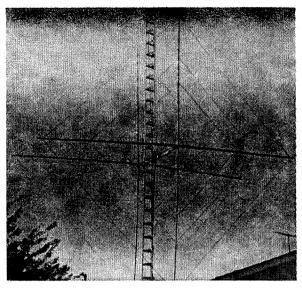


Fig. 1. Complete layout of the three band, two element quad; bamboo poles and a wooden mast provide very economical construction.



should be made of %" x 1" x 2' aluminum angle (2 each required). Weld in the center and at a right angle to the ½" wide legs. The metal may be obtained from a junk yard, some supply houses or any welding shop; take the materials to welding school or high school metal shop to be welded.

The boom to mast support bracket should be made of %" x 1%" x 2' aluminum angle (2 each required). These two pieces should also be welded to each other at right angles and on centers (see figure 3).

The boom is made of 2" x 2" lumber. One piece is 11 feet long and the other is 6 feet long. These two pieces should be nailed together with the shorter piece centered below the longer piece.

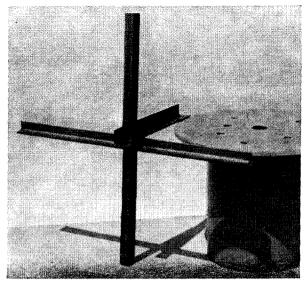
Center the aluminum boom to mast bracket on the boom, drill at least 8 nail holes through the horizontal leg and nail the assembly together.

Obtain the bamboo from a carpet store as carpets often come wrapped around bamboo poles. Try to get unsplit, straight poles 13' long and the thinner the better. You will need 9 poles and they should not cost over 25 cents each.

Cut up a couple of coat hangers into 3" lengths and form into wire hooks as shown in Fig. 3 inset.

Lay out the bamboo to the dimensions shown in Fig. 1. Drill holes through one side of the bamboo and install the wire hooks into 3 legs of the spider. On the fourth leg drill the holes all the way through the bamboo 1" above and 1" below the laid out dimensions for each spider assembly.

Assemble the bamboo to the spiders using



Construction of the homemade spreader assembly. This bracket is welded together from pieces of aluminum angle.

2 small hose clamps for each pole. Most auto stores have an ample supply of hose clamps in assorted sizes.

For each band, attach one end of the wire through the upper hole on the fourth leg. Wrap the wire around the spider and attach the end through the bottom hole. Attach the feed line to the wire ends on the driven element and solder. Short the wire ends together on the reflector element. Tape over the wire hooks to make sure the wire stays in place as it has a tendency to stretch with time.

Assemble the spiders to the boom with large hose clamps. (This is the toughest part.) Space the elements as shown in Fig. 3.

The last bamboo pole is the stabilizer. Cut it 9' long, drill a small hole through two small hose clamps and screw them to each end of the pole. Attach the stabilizer

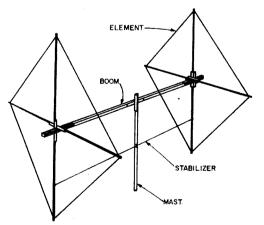


Fig. 2. Overall view of the two element quad showing the layout of the boom, mast and stabilizer.

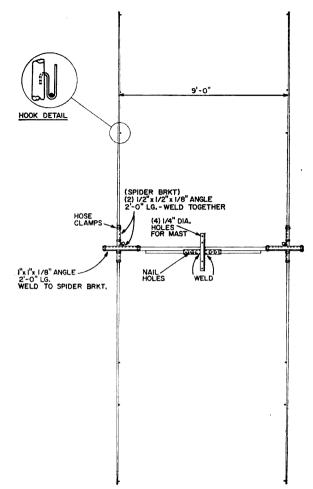


Fig. 3. Constructional details of the two element, three band quad.

about 8' down on the fourth legs between the elements and parallel to the boom.

Number 17 bare stranded copper wire is adequate for a QRP station, but where higher power is used, #12 copper wire should be employed.

Feed the array with 52 ohm coaxial cable. We found that two of the bands could be fed with the same feed line without appreciable loss, but the other band had to be fed with a separate feed line; this array has 10 and 15 meters on the same feed line with a separate line for 20 meters. It was also found that tuning stubs on the reflector were not absolutely necessary and were omitted from the installation.

We have received Q5 signal reports from Austrailia, New Zealand and Japan with 70 watts on the 10 and 15 meter AM bands. The antenna has been mounted on a 20 foot tower with good results, but much better results are obtained when mounted on a 40 foot tower.

. . . WA6WÜI

The Miniquad

The Miniquad has two unusual features. 1) It is of all-metal construction¹, thus eliminating the problems of treating bamboo and welding spiders, only to have the whole antenna come tumbling down in a year or two, and 2) It is miniaturized², taking up less than half the space of a normal two-element quad. Added features of the Miniquad are its low cost, extremely light weight, and general ease of construction. The Miniquad can be built from parts of an old beam, or it can be fabricated from scrap aluminum. It is light enough to be turned by a low-priced TV rotator.

Theory

The antenna illustrated in Fig. 1 is essentially a two-element quad with .12 wave-

length spacing. Note that the two loops are insulated from the booms and thus from each other. The horizontal dimension is .25 λ , while the vertical dimension has been reduced from the usual .25 λ to .125 λ . The difference is made up with loading coils at the bottom of each of the two loops. The Miniquad is thus rectangular, rather than cubical, in configuration. The 52-ohm transmission line is inductively coupled to the loading coil on the driven element.

Construction

The Miniquad lends itself to much flexibility in construction. The original version was built at almost zero cost from the parts of an old Telrex beam. However, eight tenfoot sections of tubing of almost any mater-

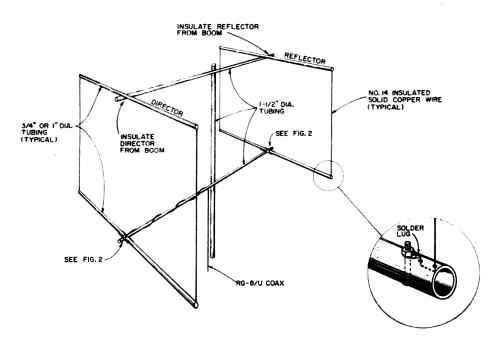


Fig. 1. Construction of the miniquad. For operation at 14250 kHz, element spacing is 100 inches, the horizontal supports are 208 inches long and the vertical distrance between the horizontal supports is 104 inches. The upper supports are insulated from the boom with standoff insulators.

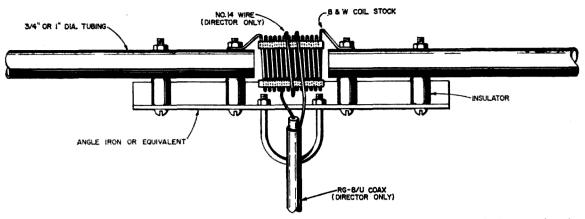


Fig. 2. Loading coil for the miniquad: a piece of coil stock two inches in diameter and three inches long is about right. The feedline is coupled into the antenna with a two or three turn loop around the loading coil.

ial and any diameter provide elements. Center mounts can be constructed of aluminum angle irons with standoffs as insulators. Masts and booms are made of TV masting. Standard antenna hardware is used for mounting the booms to the mast.

The vertical portions of each loop are of insulated number 14 solid copper wire, of the type commonly used in electrical housewiring. The wires may be attached to the ends of the horizontal elements by any convenient means. The wires should be tightened so that the top and bottom elements "bow" slightly toward each other.

Coils

The exact number of turns for the two loading coils and the coupling link depends on many factors and therefore differs for each Miniquad. The original twenty meter Miniquad has coils each made of about three inches of two-inch-diameter B&W coil stock. The driven element coil should be grid-dipped for the center of the desired operating band. Be sure to make this measurement in the absence of stray inductances.

The reflector coil is adjusted, in the usual manner, for either maximum front-to-back ratio or best forward gain. Note that no tuning stub is required on the parasitic element of the Miniquad, as the element already has a loading coil. Thus the reflector coil will simply have somewhat more inductance than that of the driven element.

The 52 ohm coax is coupled to the driven element by winding about five turns of insulated #14 solid copper wire around the loading coil. Since only this link is across the transmission line, a very low standing wave ratio may be obtained by proper choice of the number of turns.

Performance

The SWR of the twenty meter Miniquad used at WA2APT is less than 1.5:1 for the entire band, and close to 1:1 over much of the band. Transmitter output tuning is quite broad, with retuning required only for large frequency changes. Front-to-back and front-to-side ratios seem quite satisfactory.

Using 150 watts input on twenty meter CW and SSB, over 40 countries on all continents have been worked in just a few months of occasional operating, using the Miniquad at a height of only twenty-five feet above ground. All qualitative indications suggest that the Miniquad comes close in performance to a full-sized quad. Who says you can't get something for nothing?

. . . WA2APT

Footnotes

1"All-Metal Quad for 15 Meters", Edwin Fehrenbach, KZ5EG, QST Magazine, March, 1961.
 2"The Short Quad," Walter Pinner, WA8BHP, QST

Magazine, February, 1964.



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A Full Size 7 MHz Rotary Cubical Quad

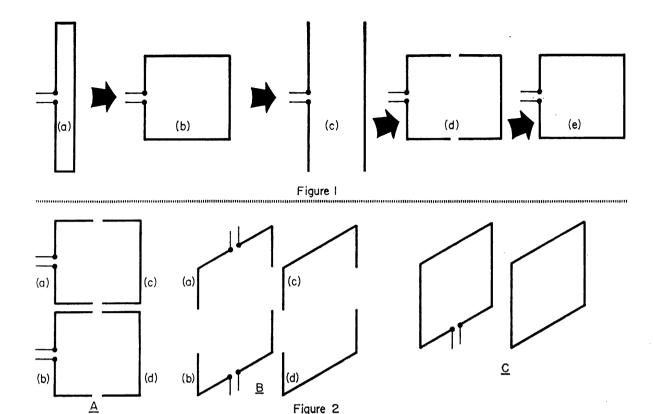
Have you been on 40 recently? Did you notice how much harder it is to consistently work DX with a moderate antenna? Here is the solution to your problem, but you must have the time, patience, cash, a large backyard and no neighbors! Although this antenna was erected way out in the country on a farm in southern Wisconsin, it has attracted considerable attention. The permanent residents of the farm have been continually asked about it and passing airplanes occasionally drop down for a closer look. The volume of this antenna is only

The full sized forty mater cubical quad. Compare its size with the barn in the lower right hand corner.

about 36,750 cubic feet, but that is enough to capture lots of DX! Compare the size of this antenna with the shed in the picture. This is not the first 7 MHz cubical quad, but it is one of the very few in existence; K6PRU used one several years ago and recently W8BAR put one up.

If one takes a simple half wave folded dipole antenna (0 dB gain), stretches it into a square or rectangle in a horizontal plane, and feeds it at an appropriate place, 3 to 6 dB gain can be obtained (Fig. 1a and 1b). This is similar to taking a 2 element parasitic beam and bending the elements 90° at a point ¼ of their own length back from each end and joining them (Fig. 1c, 1d and 1e).

If two identical antennas are properly spaced, 3 dB additional gain can be obtained; theoretically, this arrary has 6 to 9 dB gain. Suppose, however, for convenience in feeding the elements of Fig. 2A (a and c and b and d) are not connected mechanically as in Fig. 1e but are connected inductively and capacitively. Also, instead of connecting the two feedlines to a and b together, omit one feedline and connect a and b mechanically by moving the bent tips into a vertical position. Assume that the same degree of coupling can be obtained regardless of the type, mechanical or inductive. Do the same with c and d; the result is shown in Fig. 2C, the standard cubical quad. It can be seen that the radiating portions of the antenna have not been moved nor their length changed; only the method of feed has been changed. Thus, the gain should remain the same, about 6 to 9 dB.



Development of the cubical quad from the folded dipole in Figure 1 and into the two element quad in Figure 2. This development is completely explained in the text.

A full size 7 MHz quad requires supports for two squares of wire that are about 40 feet on a side and spaced 30 feet apart. A structure of several tons could conceivably be used to support these two loops of wire but a more practical way is to build a rotatable support system of minimum weight, bulk, and cost that will withstand wind, bird and ice loading.

Although I used a rather small 55 foot crank up tower, something heavier is advisable. The mast is a six foot length of 11/4" solid steel shaft; a surplus motor system with a gearbox and selsyn are mounted at the base of the shaft. The shaft is coupled to the motor through a slotted section of pipe mounted on the rotor. Right angle gears connect the shaft to a Rotobrake mounted on the side of the tower. A greased sleeve mounted in the top of the Tri-Ex tower acts as a thrust bearing. Just above the top of the tower a 24" x 12" x ¼" steel plate is mounted on the 1¼" shaft by means of four U bolt muffler clamps as shown in the photographs. On the back of this plate four home made 4" U-bolts made from 38" Redirod were installed. The 30' x 4" OD 0.06" wall aluminum boom is supported at its center by these four clamps. A sleeve of inner tube rubber around the boom restricts slippage of the boom during wind vibration and a semicircular sleeve of aluminum sheet on the outside of the rubber (on the clampside) prevents tight clamps from kinking the boom. A heavy ground strap grounds the boom to the tower and to a ground post. A bolt through the boom could have been used to prevent boom rotation but there was some possibility that this might weaken it at a critical point.

Additional boom support is provided by the boom guy system. A second steel plate is clamped on the mast just above the boom support plate (Fig. 4). A piece of pipe is clamped on the backside of this plate and holes were drilled at the ends to accommodate screw eyes. Guy wires of galvanized #9 wire run from these screw eyes to the boom tips where they are anchored with irrigation tubing clamps. These four guys hold the boom firmly in the horizontal plane.

Since the 6' steel shaft was too short, an extension of 134" OD water pipe, 6' long was mounted on top of it with two

^{*} Hq-Gain Antenna Products Corp., N.E. Highway 6 at Stevens Creek, Lincoln, Nebraska 68501.

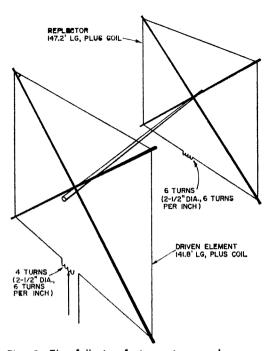
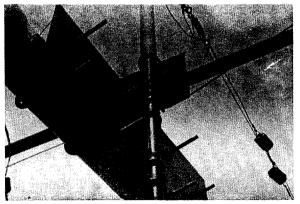


Fig. 2. The full size forty meter quad. bolts going all the way through both sections. To prevent boom sag, guy wires were connected between screw eyes mounted on top of the mast and the ends of the boom; turnbuckles permitted adjustment for minimum sag. The complete assembly is well balanced and spins on the ball bearing

mount with the twitch of a finger.

Many spider systems were considered, but the one finally adopted was developed from a suggestion of Roger Mace, W6RW. A piece of 24" x 12" x 1/8" (10 gauge) steel plate was bent 90° at the center. A piece of 4" ID water pipe was sliced into 1" wide rings; each of these was slit along one side. Two of these were welded to each plate as shown in Fig. 4.

On each side of the slits in these clamps an over-size nut was welded; a bolt could be run through these nuts to tighten the



Method of supporting the boom to the mast. This photo also shows part of the guy wire system used.

clamp snugly around the boom. Diagonal reinforcing bars of 1" x 44" steel strap were added as shown in Fig. 4. Two holes drilled at the base of the plate accomodate U-bolts; a 3" length of 1" wide, 4" thick angle iron is welded into the top of each plate flush with the 90° bend. Each section of angle iron has holes drilled in it for a U-bolt and was mounted so as to have one side flush with the other side of the angle plate as shown in Fig. 4. A thirty foot piece of 2" OD aluminum irrigation tubing was used for the central section of the support arms. Five-foot lengths of 1\%" OD tubes are telescoped inside the ends of this piece. Twelve foot lengths of high quality bamboo are telescoped inside the ends of the aluminum to give an overall length of about 56 feet. For maximum strength these bamboo poles should be wrapped with a layer of surgical gauze and coated with fiberglass.

The tubing to tubing and tubing to bamboo joints are made as shown in Fig. 4. Sleeves of sheet aluminum are placed over the arms where the U-bolts will grip them. Good quality hose clamps may be obtained from an automotive supply house for the joints. About 6 inches from the upper tip of each piece of bamboo the wood should be wrapped with tape, a hole drilled and a small pulley tied on. These two pulleys support the upper corners of the wire square and permit it to be lowered for adjustments; nylon cord is used in the pulleys.

In order to prevent the spider arms from breaking in the wind they must be properly guyed. Holes were drilled in the two 1" straps welded across the bottom of the spider plates and at the tips of two 5 foot pieces of 34" pipe; these pipes were bolted on as boom extensions. Nylon parachute cords run from the holes in the end of each boom extension to the tips of each of the four element arms. Three separate strands should be used in parallel for maximum protection. Likewise, four guys run from the other side of the element arms to an extra spider on the inner side of the boom (reserved for future additions). For further support of the arms, particularly when the wire square is lowered, nylon rope was run in a square around the bamboo arms 6 feet from their tips; the total arm guy system is shown in Fig. 5.

*Good quality bamboo will be shipped by the Sea and Jungle Shop, 4666 San Fernando Road, Glendale, California. They maintain a large stock of all sizes.

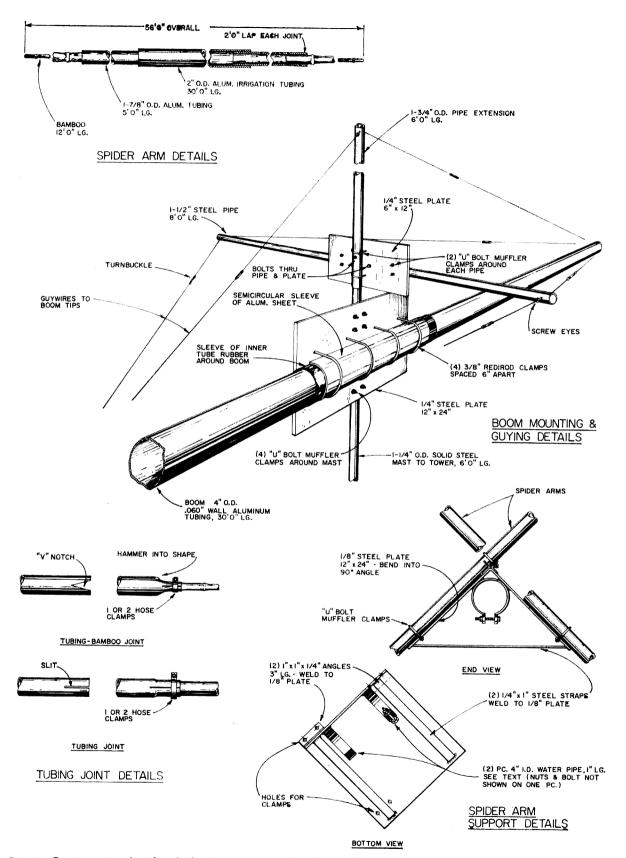
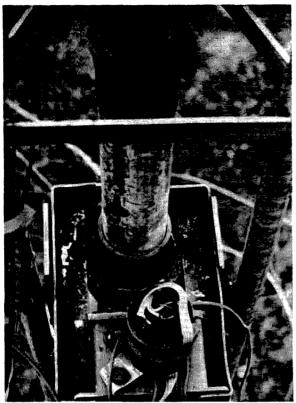
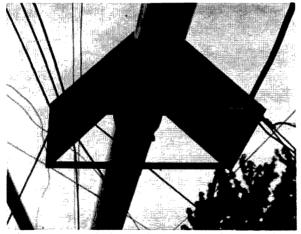


Fig. 4. Construction details of the forty meter cubical quad. This type of construction results in a light weight assembly that will withstand wind loading up to 60 mph.



Top view of the rotator mechanism. The mast is held in the slotted collar with a bolt. The selsyn may be seen in the foreground.

Assembly requires strategy but this leaves room for your own ingenuity. If you're in a hurry you may want to try the following. First of all, you need something to stand on 15 feet away from the tower and at least 20 feet high. I used a long ladder leaning against a truck, heavily guyed in



Closeup view of the spiders; this spider is midway between the mast and the end of the boom and is not used to hold the forty meter quad. It was intended for the additional of a full sized twenty meter quad at a later date. In the forty meter quad it serves as an anchor point for part of the guy wire system.

each direction. A large pulley is placed on top of the mast to haul up parts. Most of the antenna can be assembled by one person but two people make it a lot simpler.

The items are mounted in the following order: rotor, ball bearing, gears, thrust bearing, mast, Rotobrake, boom support plate, and boom guy plate. Then the spiders, guy extension arms, and boom guys with extra lengths of cord attached for manipulation from the ground. The boom is raised into place by pulley and then tied down to hang beside the boom support plate. The U-bolts, sleeves and rubber are added and the bolts tightened. The extra lengths of cord on the boom guys are used to pull the guys into place for anchoring; then they are temporarily tightened.

The four element arms are completely fabricated on the ground and their guys attached. One man can carry one up the ladder and tie it temporarily to the boom while adjusting the U-bolts and sleeves. However, it may be more convenient to have an assistant on the ground to hand you one side of the element arm while you manipulate the other side by means of a rope (don't use guy ropes tied to the tips of the bamboo for manipulation or you may break the bamboo). Make sure the pulley tips of the arms are on the ground side.

The other ends of the guy ropes are now fastened. At this point only the square of guy ropes between the individual bamboo arms will have one or two ropes unfastened 35 feet in the air. The extra spiders are 7.5 feet out from the center of the tower, but by wearing a lineman's belt and leaning way out from the tower, they may be reached to tie the guys on.

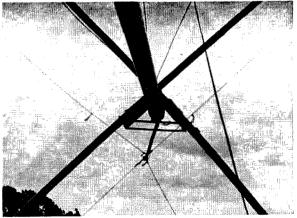
The second set of spider arms is now added. If convenient, the boom may be rotated around to put the other boom end above your ladder; the second set of arms and guys is then added in the same manner. The pulley tips of the bamboo are close to the ground and the guy rope between them is securely fastened. This guy carries more weight than the others and if possible, should be of heavier nylon rope. It should always be kept tight as it distributes the wind load more equally between the four diagonal arms.

When these guys have been adjusted and the other guys have been added to the pulley arms, the 4 boom U-bolts are loosened and the boom is rotated 180° on its own axis to put the pulley tips high in the air (if you have a derrick truck you can work on each part of the antenna without the need for boom rotation). The remaining guys are then fastened. The wire elements are prefabricated on the ground and may be pulled up with the pulley ropes and tied down. In my case it was found convenient to hang a nylon rope from the boom tip to support the heavy gamma match and RG-8/U coaxial feedline.

Considerable adjusting and tinkering was done with the elements after the antenna was mounted on the tower. The final dimensions include a coil at the bottom center of each element for length adjustments. Little efficiency is sacrificed by using coils and they are much more convenient than changing large lengths of wire. The dimensions of the elements are given in Table 1.

The resonant frequency was 7.0 MHz when the boom was 25 feet off the ground; at 56 feet the resonant frequency was 7.2 MHz with the following SWR across the land: 7000 kHz, 1.8; 7100 kHz, 1.4; 7200 kHz, 1.25; and 7300 kHz, 1.4. The resonant frequency shifted about 50 kHz during rotation due to proximity of nearby objects, but this was of little consequence because of the broadbanded nature of this quad. The gamma match uses two #12 wires 4.6 feet long and spaced 6 inches apart with plastic spacers; a series 200 pF capacitor was used to tune out the inductive reactance of the gamma match.

This quad gave very good results in the 1961 World Wide DX contest and 1962 ARRL DX contest. Africa was worked via long path and European hams were heard on the long path around 1400 GMT; DX worked included HV1CN, FB8XX, TU2AL,



The spider supports used at the ends of the forty meter cubical quad.

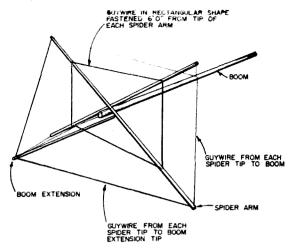


Fig. 5 Guying system used with the spider arms. Without this system the arms will break in winds of 30 to 40 mph.

VK5XK/VK9, EP2BQ, VS9AAC, and ST2AR. The quad compared very favorably with full size two element beams of similar height in the USA but no local beams were available for comparison. JA's were worked one after another in the morning and stations running 5 to 20 watts from several continents had good 559 and 569 signals; Europeans have been as strong as 40 db over 9 on a 75A4. The quad consistently got very good signal reports and often, "First W9 on 7 MHz".

The front to back ratio runs from 5 to 40 db depending on the direction, angle of radiation and skip characteristics. Numerous observations of 7 MHz broadcast stations and hams showed average gains of two S-units or better over a 1000 foot longwire aimed at Europe. Nearly all work has been on CW with 900 watts, but with a borrowed SSB exciter all continents except Asia were easily worked.

The antenna has stood up well in 50 to 60 mph winds, snow, and ice as long as all guys were kept tight; if the guys are not tight the arms will break in winds of 30 to 40 mph. This antenna is a joy to operate with on 40 meters, but you must take a bit of time to build and maintain it.

I wish to express my appreciation particularly to my tolerant landlady, Mrs. Ellen Richardson, to Alice and Otis Onsrud (Mr. Onsrud contributed the expert welding), Tom Leffingwell, and Donald Weinshank. Also to W4VRD, W6RW, K9ELT, K9KNC, W9SZR, and to all the others who have helped.

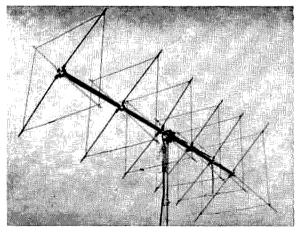
. . **K**6DDO

Experiments with Quad Antennas

Over the past few years I have constructed a number of antennas, largely based on data collected from the various ham magazines. In most cases however, I wasn't completely satisfied with the results; also, the dimensions varied from one article to another and the gain figures given by the authors seemed to be somewhat excessive.

I decided that the only way I was going to get a proper answer was to conduct a little basic research. With the few instruments that I have at my disposal, and a lot of cut and try, I think I can now provide some useful information on the construction of cubical quad antennas.

My first experimental quad antenna was designed for 145 MHz. This antenna was designed in such a way that I could vary the dimensions, spacing and height from the ground. Since I didn't have a lot of exotic antenna testing equipment, I made do with what I had. The resonant frequency of the elements was found with the aid of a grid-dipper and a communications receiver; the front-to-back ratio, minimum radiation angle and attenuation off the sides of the antenna were determined with three separate field strength meters. In addition, an antennascope was used to measure the input im-



The six element quad for two meters is centered on 145 MHz. This antenna has a boom length of 144.5 inches, just a hair over twelve feet, and has provided excellent results on two meters.

pedance to the quad and an SWR meter used to check the match.

With this simple test equipment I closely examined a three element quad for two meters and the effects of element spacing, height above ground and various elements dimensions. To insure that the results were not just casual but repititive, the tests were conducted over a three month period and have been repeated three times; in each case the entire antenna was completely disassembled and re-assembled. After I had completed all the tests on the 145 MHz quad, I used the experimental data to develop a three element three band quad for 14, 21 and 28 MHz.

Obviously, to construct an antenna for three different bands, I had to make compromises to obtain optimum results on all three bands. During the course of my experimentation I was able to establish that when a reflector was adjusted by means of a stub on the lower part of the square, the antenna became asymmetric and lost considerable gain in the horizontal plane. Therefore, two stubs should be used to adjust the reflector and other parasitic elements; one on the upper side of the reflector and one on the lower side. In addition, these two stubs should be adjusted together. This solution practically precludes adjusting an antenna for 14, 21 and 28 MHz, so I completely removed the stubs and made all the sides of the quad perfectly symmetrical. I also found in the course of my experiments that the alignment between the wires of the various elements is very important.

After completing the experiments with the model antennas, I built a full size three element quad for 14, 21 and 28 Mhz. This antenna has been placed on a support projecting 5 meters (about 16½ feet) from the roof of my house. This antenna is fed with a single transmission line; two relays mounted in a water-tight box switch in the proper radiator when I change bands. It is highly advisable to use a ¼ wavelength of transmission line (or an odd multiple) between the relay switch box and the radia-

Quad Dimensions

Band	10 Meters	15 Meters Total Length of Wire	ZO Meters used in each element	2 Meters	
Reflector	1079 cm (424.8 in)	1470 cm (578.7 in)	2204 cm (867.7 in)	216 cm (85.0 in)	
Radiator	1029 cm (405.1 in)	1403 cm (552.4 in)	2103 cm (828.0 in)	206 cm (81.1 in)	
Director	978 cm (385.0 in)	1333 cm (524.8 in)	1997 cm (786.2 in)	197 cm (77.6 in)	

Spacing between elements: on the tri-band beam for 10, 15 and 19, and 20, the director is spaced 260 cm (102.4 in) from the radiator; the reflector is spaced 230 cm (90.6 in) from the radiator. For the six element two meter quad all spacings are in reference to the radiator and are as follows: reflector, 31 cm (12.2 in); 1st director, 29 cm (11.4 in); 2nd director, 63 cm (24.8 in); 3rd director, 96 cm (37.8 in); and 4th director, 148 cm (58.3 in).

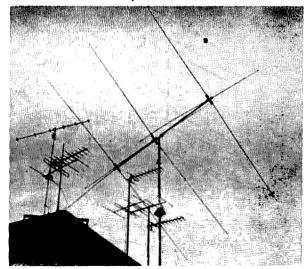
tor element. You definitely should *not* tie the three radiator squares together to facilitate feeding by a single transmission line; the gain and directivity are completely destroyed.

Mechanically the beam was constructed by using a boom of extra-light steel tubing on which three cast aluminum cross-pieces are threaded. Bamboo poles were used to support the wires. At the points where the wire squares are fixed, stainless steel springs have been mounted to keep the wires taut and in alignment without subjecting the bamboo supports to flexing. These springs also compensate for the lack of symmetry of the poles after they are mounted on the boom. After the wires and stainless steel springs were mounted, all the bamboo poles were given a coat of protective paint.

Where the poles are attached to the crossarms, a small sheet of thin rubber 6 mm thick (about 14 inch) has been inserted to make the joint more elastic. The poles are then fixed in place with galvanized U-bolts. The preparation of the wire squares requires the utmost in accuracy; the data shown in the following tables should be followed as closely as possible. The easiest way to accomplish this is to unwind the wire, measure a length 20 cm long (8 inches), form a small eyelet in the wire and solder it so it provides a reference point for the subsequent eyelet. Each side of the square is carefully measured until the whole square has been made; the first length of wire is used to close the last side with a solder joint. Close attention to this procedure greatly facilitates the final assembly, and permits easy installation of the eyelets at the corners over the stainless steel springs. The same method may be used for the construction of a 144 MHz quad, but for the two meter version the bamboo should be replaced with a material that has better rf characteristics.

The results obtained with this antenna are best illustrated by comparing it to a multiband commercial unit. The front-to-back ratio is not maximized because of the compromises made in dimensions to permit optimum operation on three bands. However, on 20 meters the front-to-back ratio is on the order of 22 dB. The vertical angle of radiation appears to be lower than that of a two element quad, but unfortunately, comparative tests are difficult to evaluate in terms of radiation angle and front-to-side ratios. The actual operating results have been excellent; with only 16 watts input on 14, 21 and 28 MHz, I have had excellent results working DX stations.

I have also been extremely pleased with the results obtained with the six element two meter quad; this antenna has consistently out-performed large commercial antennas installed by local amateurs.



The three element quad for 10, 15 and 20 meters. The SWR on all bands is less than 1.5:1, even at the band edges. On 14.00 and 14.35 MHz for example, the SWR is 1.4:1, at 14.18 MHz it is 1.2:1; at 21.00 and 21.45, the SWR is 1.2:1, at 21.23 it is 1.1:1; and on 28.2 and 29.5 the SWR is 1.4:1, at 28.8 it is 1.2:1. SWR checks with both Heathkit and Jones Micromatch bridges provided almost identical results.

... IIRR

The Half Quad Antenna

A muscular version of the inverted V dipole

Thirty some odd years ago, E. J. Sterba developed a form of stacked dipole antenna which bears his name. Although the Sterba curtain is not too popular with radio amateurs, it is, none the less, an excellent antenna. The Sterba, as you no doubt know, is the grandaddy of some antennas that enjoy great popularity today.

The lazy H, a simplified version of the Sterba in its basic form, is one of the descendants of the Sterba, and was introduced to the amateur world by W6BCX. From the lazy H, the same gentleman, W6BCX, developed the bi-square by combining the half wave elements in the form of a square. The bi-square dimensions, particularly at

the lower frequencies, become rather ungainly mechanically, so it was inevitable that someone would find a way to reduce the size of the half wave sides and still retain reasonably good gain. We know this reduced size bi-square, with one quarter wave length sides, as the cubical quad. Now, let's take the quad and reduce it in size by slicing it in two, leaving only the top half. This remaining half, for want of a better name, becomes a half quad.

The main advantage of the half quad is that it can be erected for the 40 and 80 meter bands without resorting to the use of broadcast station size towers. The half quad employs wire elements, supported in

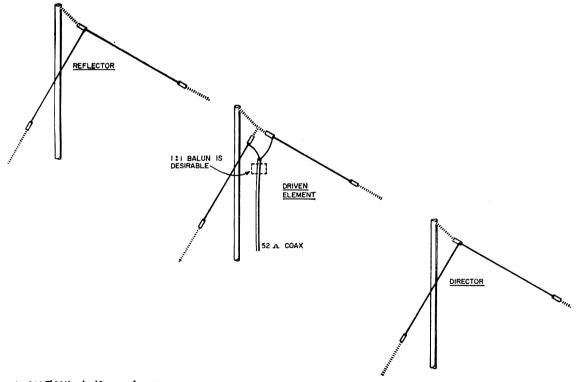


Fig. I. WØSII's half quad antenna.



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contour of your bumper, providing the strongest, best looking mount for your mobile antenna.



Half Quad Dimension

Half Quad Dimension

7.1 MHz 7.2 MHz 3.8 MHz 3.9 MHz Reflector 69'10" 68'3" 129'2" 126 Driven Element 66' 651 1231 120' 62'8'' 41,3, 106'10" Director

One quarter wave length, for element spacing, (In Feet) = $\frac{246}{\text{Freq (MHz)}}$

the center with a single pole. The elements are slanted down toward ground at an angle of approximately 45 degrees (See Fig. 1). The parasitic elements are attached to the poles with small insulators, and the driven element is constructed and attached to its pole in the normal inverted "V" fashion.

The two or three element version of the half quad, with one quarter wave spacing between elements, will give good gain and allow the array to be fed directly with 52 ohm coax cable. With one quarter wave length spacing, the feed impedance of the half quad, using the two element version with a driven element and reflector, will be about 60 ohms. The three element half quad will give a feed point impedance of approximately 30 ohms. The gain of two element half quad is 4.5 dB, and for the three element half quad, 8 dB.

The half quad at this QTH is the 40 meter size, suspended from 50 foot poles, and oriented on Australia. The reports on SSB, received from the VK's, range from S-5 to S-8, a very respectable performance from a horizontally polarized antenna with an average height of about one quarter wave length above ground.

As an added note, and with apologies to an old acquaintance Dr. John Kraus, the W8JK Flat-Top array can be rigged in the Half Quad manner, when a bi-directional pattern is desired.

. . . WØSII

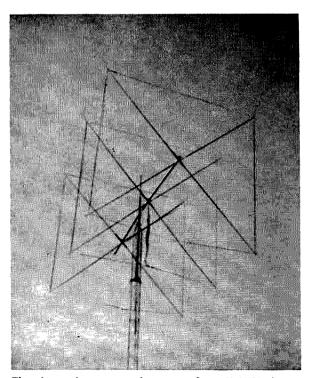
Inexpensive Equipment Feet

The "Self-Stik Flan-Tabs" are an excellent and cheap source of scratchproof feet for small equipment cabinets, mini-boxes and the like. They are green flannel covered discs with a pressure-sensitive adhesive on the back and come in two sizes, % inch and % inch, 32 to a card for 29c in dime stores.

. . . Edwin Hill W3URE

The Three Element Quad

It is certainly not an "old wive's tale" when someone speaks about the performance results of the two element cubical quad. The gain is comparable to that of a three element yagi. From personal experience, the front-to-back ratio ranges from 25 to 30 dB, with the front-to-side ratio reaching as much as 40 dB. For the size of the antenna it packs a mighty punch in the roughest of pile-ups, and amateurs around the world will attest to its performance. Another favorable aspect of the quad is the relatively low construction cost.



The three element quad as seen from K8YIB's house shows the director, the driven element, and the reflector. The boom consists of three inch irrigation tubing and the spreaders are bamboo.

As we all know, most amateurs are never satisfied with their antenna, so we decided to go one better, and try a three element quad. There was very little information available on this type of antenna, nevertheless the problem of design and construction was undertaken.

Design

The dimensions for the three element quad were taken from WØAIW's dimensions for his four element quad. It was thought that we had to start somewhere, and Lee's figures looked good. Originally the boom length was twenty-five feet, but after running some tests on the air with local and out-of-state stations, it was decided that the front-to-back ratio was suffering badly. Thanks go to WAØIOR, Hal, whose suggestion to shorten the boom length was a great help in the final success of the antenna.

Construction

Spreaders: Fiberglass poles make excellent, durable spreaders, but are guite expensive. Bamboo poles also suffice, but do not weather well unless they are protected. A few coats of Spar varnish will last several years, but if the poles are fiberglassed, they will last indefinitely. Fiberglass resin and fiberglass cloth are available at most boat centers and sport shops. The bamboo poles were cut to a length of thirteen feet, and wrapped from the small end to the butt with three inch wide fiberglass cloth. About half a quart of resin was mixed at a time, and applied with a paint brush. About two days are required for the poles to dry.



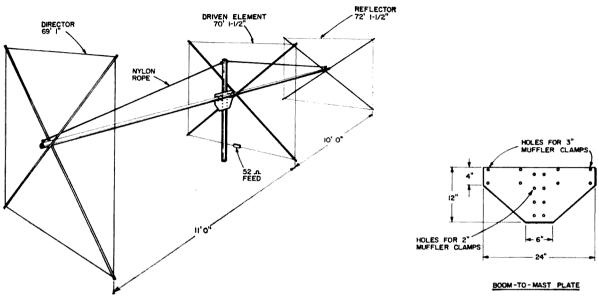
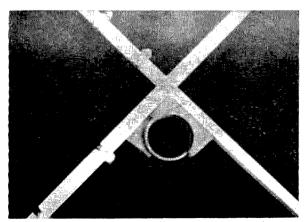


Fig. 1. This three element quad for twenty meters provides extremely wide bandwidth as indicated by the low SWR throughout the band. The construction of this quad is straight-forward and only requires a boom length of 21 feet.

Supporting crossarms: Three foot sections of one inch angle aluminum were used to hold the poles to the boom. The muffler clamps used between the angle stock and the boom are three inch. The bamboo poles are held to the angle aluminum by one and a half inch hose clamps.

Boom: The boom consists of twenty-one feet of three inch irrigation tubing. The spacing from the reflector to the driven element is ten feet, and the distance from the driven element to the director is eleven feet.



The supporting crossarms.

Stringing the elements: Number fourteen wire was stretched out and marked at 69' 1" for the director, 70' 1½" for the driven element, and 72'1½" for the reflector. After the crossarms had been assembled, the spreaders were staked out perpendicular to each other, and each element was strung.

Assembly and tuning: Each element was fastened to its respective position on the boom, and 52 ohm cable was attached directly to the driven element. Tuning stubs were fashioned out of #12 wire and fastened to the director and reflector. The antenna was raised to approximately twenty feet, and the stubs were adjusted to give maximum s-meter readings on a receiver beneath the antenna.

Repeated comparisons with a nearby station, on the long and short haul DX, seem to indicate that the three element quad is comparable to his four element yagi. The front-to-back and front-to-side ratios are as good if not better than the two element quad.

Over 200 countries have been worked in the last six months, and good success has been experienced in the pile-ups.

. . . **K8YIB**

A Light Four Element Quad for 20 Meters

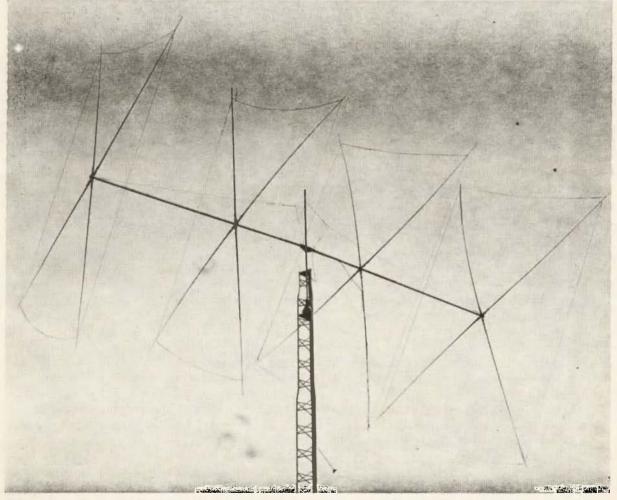
Now that Spring is here it's time to think about improving your antenna system.

Why the antenna and not the transmitter? Well it's easier to increase power in the antenna than it is to improve output power in the transmitter.

For example: If one ham in town puts up a quad that gives 10 dB gain, then another ham in the same town would have to increase his output power 10 times to get the same signal report. A 100 watt station using this same antenna would be as strong as his neighbor running 1,000 watts to a dipole.

A recent survey among leading DXers in the world shows that the six element beams and the four element quads put out the "big" signals.

Most people don't have the room or the money to put up a six element beam but



A tour element quad for 20 meters. This antenna weigns less than 50 pounds and has witnstood winds up to 80 miles per hour.

MAY 1967

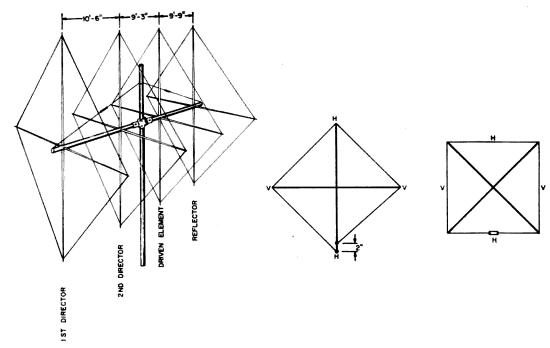


Fig. 1. Overall view of the four element quad for 20 meters; the total boom length is nearly 30 feet. Either diamond or square construction may be used as shown on the right, but the square model requires insulators—one in each element.

a four element quad doesn't take too much space and is considerably cheaper than the beam.

In the past, four element quads have been bulky, very heavy and parts were hard to come by. Today a four element quad can weigh under 50 lbs. By using lightweight fiberglass arms (16 of them) each weighing only a pound and by using a lightweight aluminum boom and using aluminum braces to mount the arms to the boom all totals up to a lightweight four element quad that can be supported by most towers capable of supporting a tri-band beam.

A 2" x 30' x .065 wall tubing spec. 6061ST-6 boom will support the lightweight arms and has a lower wind resistance than the 4" boom used in the past.

The least expensive arms for a quad are made of wood or bamboo. These arms can crack, split, warp and are easily broken during construction or by the wind after construction.

Commercial fiberglass is now available within the price range of the average income. This fiberglass is made especially for quad antennas and is manufactured by several companies. These lightweight arms sell for about \$5 each or \$80 for the 16 arms.

Quad arm mounts are also available for around \$5 each or \$20 for the 4 mounts.

Boom to mast clamps are available but be sure that they are big enough to support a four element quad. The support should be 12" x 2" O.D. for the boom and 6" x 1½" O.D. for the mast. The clamp on your old antenna might do the job or order one from an antenna manufacturer.

The clamp must be capable of supporting both the 2" boom and the 1½" mast above and below the boom (Fig. 2).

About 50' of ½" galvanized guy wire, 2 heavy duty turnbuckles and 8 cable clamps are needed to give the boom additional support (Fig. 1).

Several companies offer all of these parts for under \$150 including the boom. This price can be cut if one makes any of the parts himself or has them on hand from other antenna projects.

There is no real difference between a quad shaped like a diamond and one shaped like a square. The important thing is the feedpoint (Fig. 1). Feeding the antenna at any point marked H results in horizontal polarization and feeding at any point marked V will result in vertical polarization.

The most widely used polarization is horizontal. It is easier to tune the antenna and the tower will have less effect on the antenna than if vertical polarization would have been used.

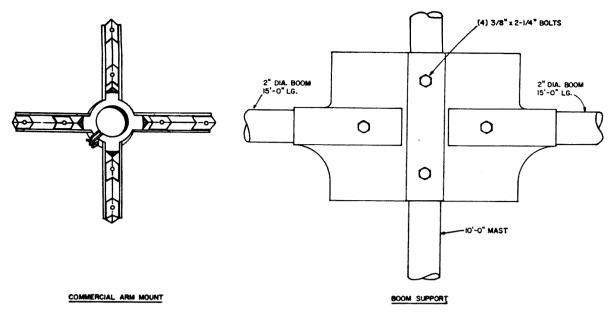


Fig. 2. The commercial arm mount and boom support used with the four element 20 meter quad. This particular design has withstood winds up to 80 miles per hour.

The diamond quad offers an excellent route for the feedline to be run. The feedline can be taped directly to the fiberglass arm with no ill effects. The square quad requires 4 insulators, one for each element (Fig. 1).

A quad is not an especially broad-banded antenna; the SWR can be tuned to almost 1 to 1 at any one frequency but the SWR rises more rapidly than does the SWR in many beams. This is not a serious drawback as the SWR is under 2 to 1 over most of the band (Fig. 3).

The resonant frequency can be changed easily by lengthening or shortening the wire or by using coils, shorted stubs, tuning stubs or other tuning methods.

The length of the wire on each side of the quad can be calculated by using the formula 248 or the formula 984 for the total length of each loop. The approximate total length of the wire for the 20 meter phone band is:

1st director	66'	6"
2nd director	68'	3"
driven element	70′	0"
reflector	71'	9"

The above lengths were calculated by increasing the driven element length 2½% for the reflector and by decreasing the directors 2½% from the driven element size.

The radiation resistance of the quad will be close to 50 ohms and the greatest gain

will be achieved when the elements are spaced:

1st to 2nd director 10' 6" director to driven 9' 3" driven to reflector 9' 9"

This uses all but 6" of the 30' boom.

- Select a flat place in the yard to lay out the quad arms. Mount the arms to the arm mount. Do this to each of the 4 mounts.
- 2. Drill ¹46 holes in the arms approximately 12′ 1″ from the center of the boom; drill a 2nd hole at 12′ 3″ in the bottom arm of the driven element. Be sure to drill all holes straight and in a level plane.

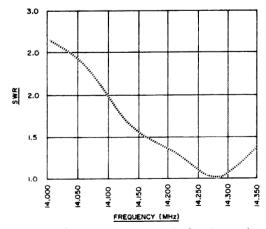
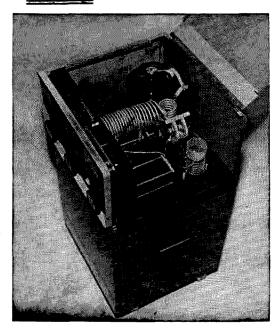


Fig. 3. Standing wave ratio of the four element quad. Although this unit was tuned for minimum SWR in the phone section of the band, even at the low end the SWR barely exceeds 2.5:1.

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- 3. Thread the wire, #14 enameled copper, through each hole, and on the last arm connect the 2 ends together and solder forming a closed loop; do this to each element.
- 4. Drill a ¼" hole about 1" from each end of the boom.
- 5. Attach a 10' x 1½" mast at its midpoint to the boom.
- 6. Drill ¼" hole about 2' down from the top of the mast parallel to the boom.
- 7. Slide the elements on the boom (a little grease or butter on the boom might help).
- 8. Attach feedline (52 or 72 ohm coax) to the driven element and run the coax along the quad arm and boom taping it with permanent black tape as you go.
- 9. Push 5' of the ¼" cable through the holes in the mast and attach the turn-buckles to each end of this wire. Cut the rest of the steel cable evenly and attach the wire to each end of the boom and to the other end of the turnbuckles (Fig. 1). Be sure that the turnbuckles are as wide as they will go before attaching the cable.
- 10. Raise the antenna to the top of the tower and drop it into place.
- 11. Tighten rotator bolts.
- 12. Tighten turnbuckles so that the boom is straight.
- 13. Run the feedline through the inside of the tower. Drive a 8' ground rod into the ground as near as possible to the base of the tower. Connect the outside braid of the feedline to the ground.

This quad has survived winds of 80 mph on a self-supporting tower 50' above the ground. If additional strength is desired a piece of wood or similar substance can be run through the boom to give additional horizontal support.

The gain of the antenna varies according to what method of measurement is used. Comparing this antenna's gain to what manufacturers claim their antennas get, this antenna exhibits a gain of about 12 dB. This gain was measured by using a S-meter in a communications receiver using a dipole 10 wavelengths away from the antenna.

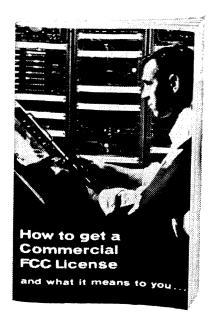
This is more than enough gain to work most stateside and DX stations using either high or low power.

. . . KØUKN

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It tells how to go about getting the key to job success in the growing electronics boom—a Government FCC License



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Tilt that Quad at A Dollar A Foot

When the quad bug hit me three years ago, a basic fact of antenna design came into sharp focus. The delta-quad configuration I planned was comparatively new, and I had no doubt that there would be a long period of pruning and tuning. This called for a simple method of raising and lowering the antenna. Even if my calculations were accurate, I knew the antenna would have to go up and down dozens of times so that it could be adjusted for this particular location in order to correct for the individual conditions such as our unusually poor ground, the proximity of the carport, power lines, etc.

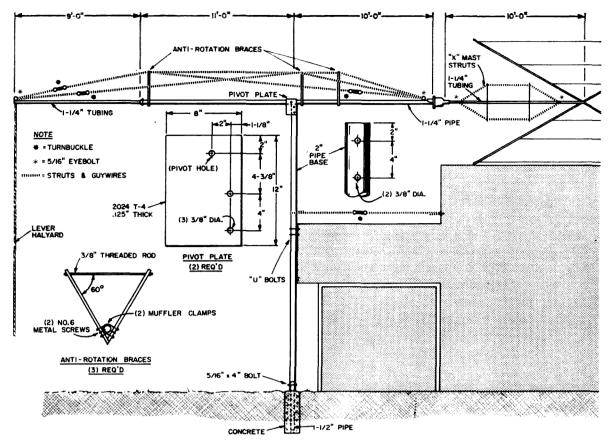
So before the antenna itself was touched, I concentrated on a "tower"-a somewhat generous term-that would permit quick, easy adjustment. Consideration was given to several of the sturdier crank-ups, tilt-overs. Had I been able to afford one of the more de-luxe commercial models, particularly those with power driven winches, there would have been no problem except that of adjusting, cutting, trying and re-adjusting at the 20' level. The cost of this equipment, however, went far beyond my classification or hobby expense, so I gave the question considerable thought and came up with the gadgetry shown in Fig. 1. It is ultra-simple, delightfully inexpensive, and completely effective for lightweight antennas.

Basically, the tower consists of two parts: a solidly set fulcrum at a reasonable height, a lightweight lever arm that would be able to take punishment. The whole works had to be high enough to raise the spider of the quad to a 41' height (half-wave on 20 M. for the bottom part of the quad square); had to be able to live with summer windstorms with gust velocities of at least 65 MPH.; and had to make the raising-lowering procedure a matter of minimum effort and time. I felt that it could be done at a low cost. It can.

There are two basic elements:

The fulcrum

A height of 21' seemed like a good fulcrum point for two reasons. First, it would allow the antenna to be lowered to the roof of the house at an angle that would allow me to make adjustments easily. Secondly, standard 2" black or galvanized pipe comes in such lengths, and with somewhat limited tools, I wanted to keep work to a minimum. I was fortunate in being able to buy from a local surplus metals dealer a piece of lightweight black pipe which has the same outside diameter (2.375"), but has a lighter wall (.121" vs. .154"). It is lighter in weight, easier to handle and drill, and is cheaper in price. To use this pipe as the fulcrum requires the drilling of two parallel %" holes at one end, 2" down from the end and 4" apart. (See Fig. 2). An anti-rotation bolt is added later. The fulcrum materials include, in addition to the pipe, two pieces of %th inch aluminum, 8" x 12" of a hard alloy such as 2024 T4 or harder. They are drilled with holes to match those on the pipe as shown. The additional %" hole higher and to the left of the mounting holes, is the actual pivot point. Machine bolts, %" x 4", hard-drawn and with lock washers are used to secure the two plates to the pipe. Mounting to the side of the house or carport is a matter of material available, personal choice, etc. A simple method is shown in Fig. 1. A 4' length of 1%" pipe was set in a chunk of concrete roughly 1' x 3' x 3' deep, with about a foot of the short pipe above ground, slightly offset from the facia boards of the carport. The base fulcrum is erected in as vertical position as possible by slipping the lower end over the stub in the concrete and tying the upper portion to the house facia in the most convenient and sturdy manner. Drill a 5/16" hole through both pieces of pipe and use a 5/16" x 4" hard-draw machine bolt to keep the 2" pipe from trying to rotate. Here I used two "U" bolts securely anchored



to the facia, plus a guy wire tightened with a turnbuckle to another facia board. For the base section, that's it!

The lever

The basic component of the lever is a 21' length of I%" black pipe with a %" hole drilled at a point 11' from one end for the pivot bolt. At right angles to this hole, two $\frac{1}{16}$ " holes are drilled, one 1" from the end of the 11' side, the second 7" from the 10' side. These are for the eye bolt used for the bracing cables, and the bolt used to attach the extension arm.

The last major piece of material is a 21' length of steel tubing with an OD of 1¼". I buy these in Phoenix from wire fence contractors for about \$3.25 per length. This tubing is amazingly resilient, and has been used for dozens of tough antenna chores. Cut off ten feet of this length, and set it aside for the top section of the whole works. The lower section is drilled at one end with a ¾6th" hole to match the anchor bolt, and with another ¾6th" hole about a foot from the end to match the hole in the I¼" pipe so that the pipe and tubing can be bolted into one unit.

Examination of the sketch of the lever will show that there is a heavy strain on it when it approaches the horizontal position. A pair of braces attached to the arm itself transfers this load to a 3/16th" bracing cable. I use two pieces of scrap aluminum channel, about ½" x ½" x 2'6" at each of the two brace points, secured to the pipe by "U" bolts. Really throw your weight into getting

Material List Approx.	Cost
1 length 2" pipe, black or galvanized 21' Fulcrum Base	\$11.00
l length 1¼" pipe, black or galvanized 21' Lever arm l length 1¼" steel tubing 21'	6.75
Lever extension and top mast	3.00
2024 T-4 or similar pivot plates	3.00
1 pc. 1½" galvanized pipe, 4' long	1.25
or similar for lever arm strut braces 4 pcs. aluminum channel, as above 4' long for cross-bracing top mast—if top mast	1.80
cross-bracing is used	4.80
15' additional if second facia tie is used Cable clamps, "U" bolts, eyes as needed for	.75
your own variations, plus turnbuckles 60' 4'" nylon cord if top mast cross	5.00
bracing is used	1.80
20' 4" nylon cord, or equiv., for lever halyard	
	89.75

The above materials can be purchased at better than these prices in Phoenix from concerns dealing in surplus metals. And even at these prices, with a generous \$5.00 for miscellaneous small parts, you are over 40' at less than a dollar a foot . . . What is more important, you can really tune that antenna.

these on tight. A turnbuckle on the cable makes sure the arm is in proper tension, and basically, we have the lever. With your rotor mounted at this point, you are now slightly more than 31' above the ground.

Up to 41 Feet. Remember that 10' length of IX" tubing? For a light UHF beam, we've got it made. For a heavier antenna like the DeltaQuad used here, however, the weight (about 25 lbs.) plus the greater wind resistance made me spend a little more time and effort on that top 10' . . . I cross-braced twice along the length, using the same aluminum channel with two feet extending out on each side of the crosses formed. Since these were inside the quad itself, I used " nylon cord instead of steel cable. Its "stretch-shrink" cycle has had no apparent effect. The antenna bolts to the top of this braced mast. Center of the spider, 41 feet! The usual egg insulator-broken guy wires are attached to the AR-22 rotator here.

The only other item consists of a 20' length of cord, strong wire or cable which is connected to the bottom of the lever arm. When the antenna is lowered, this halvard hangs down to the ground and is pulled until you can grasp the bottom of the lever itself.

Assembly

Erect the fulcrum post as shown making sure that it is vertical. Raise the lever arm. complete except for antenna, to the roof. It may take a little help to thread the lever arm into the pivot slot, but I do the job myself with an inexpensive block-and-tackle on the top of a very makeshift gin-pole. It takes a ladder to get to the pivot point, and without the gin-pole, getting the \(\mathbb{Y}'' \) x 4" pivot bolt can be something of a chore, but with a little push-pull help from a man on the roof, the job can be accomplished in a few minutes. You should be sure as you do this that the halyard at the bottom end of the lever is loose and falling to the ground. Attach your preliminary guys to the rotator, attach the antenna and its coax, and you are set.

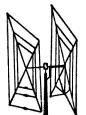
The amount of pressure required to raise the antenna depends on its weight and how closely you have stayed with these materials. For this installation, a 23 lb. bucket of sand exactly balances the weight of the whole upper lever complex: next chance I get to pick up a chunk of lead, etc., I'll cut that down.

Raising and lowering

At this QTH, the antenna is attached to the carport on the west side of the house. To lower it, I rotate the quad to the east or to the west, depending on which element I want to work on. I then detach the rotor guy on the west side, release the simple lock that holds the lever to the fulcrum arm and raise the lever so that the antenna starts down. The lever is slowly raised, finally goes to the point that the lever cord is used for the final distance as the antenna comes down to the roof. Outside of antenna rotation. total elapsed time, 10 seconds. After completing the adjustment, the lever cord is pulled and the process reversed. Maybe 15 seconds. Energy expenditure,—little.

On the basis of material costs in Phoenix, we are talking about a total figure for the entire gadget, less guys of about \$40.00. The "Tower" has been up for over two years in various sizes and variations. It has taken a lot of punishment from the wind. And most important, it has enabled me to have the antenna easily available for every possible change with the greatest of ease. 1 think it is a first class investment.

. . . W7UXX



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An Easy-to-Erect Quad

If you want the best antenna for DX, and the one which is easiest for the home constructor to erect; then the antenna for you is the cubical quad.

Now, the first statement is easily confirmed. It is only necessary to sit on the fence and hear what all of the big (and usually rare), DX stations use. I find personally that at least 60% of all European stations use quad antennas.

The second statement is usually not so easily proven. If you have ever struggled up a tower with a twenty-meter beam on your shoulder, or almost slipped a disc when your cubical quad got caught in the stay wires at the thirty-foot level, then I am sure that you agree. There is one way

out here, and that is to erect the antenna in two parts, the driven elements and boom in one part, and the reflector assembly comprising the rest.

Fig. 1 shows the boom and driven element section before erection. Ready-made quad parts are not easily available in this country, so we had to start from scratch. We made the boom from 2"OD galvanized water pipe. A %" mild steel plate 6" square is welded to each end of this pipe. One plate has four ¼" holes drilled as shown in the photo, the other end plate has four radial supports welded in place at an angle of approximately 20 degrees to the plate. The third plate has four ¾" holes drilled in exactly the same positions as in the first



Fig. 1. Boom and driven element section before erection.



Fig. 2. VK5DS holding the driven element section of the quad.

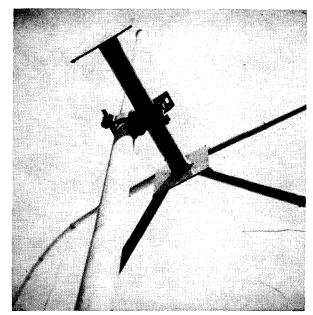


Fig. 3. The boom is attached to the mast with a builder's scaffold clip.

plate as well as the other four radial supports, which are welded, also at 20 degrees.

These eight radial supports are made from galvanized 1" OD steel tubing, each being two feet long. The radials themselves can be made of anything. We used Australian oak, (a long-grained timber), and finished them with marine paint. Fiberglas fishing rods would be better, if available. Whatever material is chosen, the radials need to be about 13' long.

Element lengths can be found in Bill Orr's Quad Antenna Book, and it is strongly suggested that the wires be laid out on the ground and individual lengths marked off so that they remain symmetrical when wound onto the radials.

Erection, as mentioned earlier, is very simple. It is quite easy to handle the individual parts of the antenna, as VK5DS demonstrates with the driven elements in the accompanying photograph. (Fig. 2)

The tower at VK5VB is a 60' Homelite; we climbed to the top and hauled the driven elements up on the end of a piece of rope, which was tied around the boom. The boom was attached to the rotator (2"OD pipe), with a builder's scaffold clip (Fig. 3). We have found these fittings a most convenient way out of the problem of fastening which everyone seems to have with antennas which are too heavy to use TV fastenings.

The other elements are then hauled up the tower and fastened to the boom-plate with four ¼" bolts. (Fig. 4)

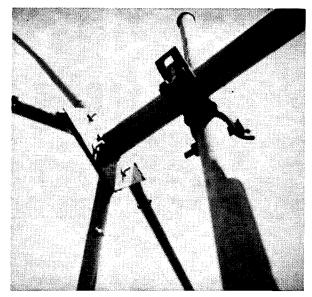


Fig. 4. The other elements of the quad are raised with a rope and fastened to the steel plate on the opposite end of the boom from the driven elements.

If a crank-up tower is used it becomes that much simpler to mount the thing. You can then climb up a stepladder with the antenna sections one at a time and it becomes a one man operation.

We drive each section of the antenna separately with 72 ohm coax and the radiation resistance is correct on all bands up to 50 MHz. This of course is largely because the correct ratio of reflector/driven element spacing has been maintained on all bands.

The finished job, whilst not aesthetically appealing to my wife, I think looks pretty good (Fig. 5).

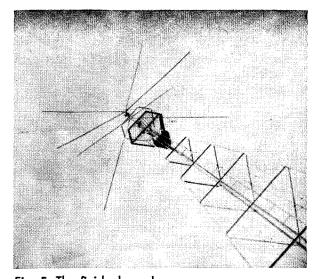


Fig. 5. The finished quad.

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Since the first published description of the cubical quad by W1DF in QST for November 1948, there has been a veritable flood of quad articles published in the amateur magazines. W1DF noted in his article that the quad apparently originated HCJB in Ecuador; from this rather obscure beginning the quad has grown into one of the most popular amateur antennas. There are two element quads, three element quads, four element quads, quad kits and quad packages-with sizes and prices to fit nearly anyone's space and pocket book. The following is a comprehensive list of cubical guad articles that have appeared in the ham magazines since WIDF's original description back in 1948.

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"Two Band VHF Quad," W6SFM, 73, July 1963, page 50.

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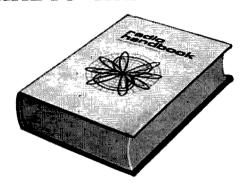
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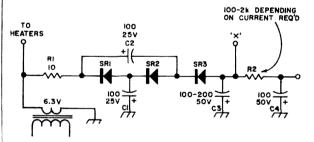
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. . . Jim Fisk, W1DTY

Simple Bias Supply

Possibly the reason that many amateurs do not use protective bias in their transmitters is that bias supplies are usually expensive and hard to locate. There are very few transformers that are suitable for bias supply use on the surplus market and new ones are costly. A very simple supply can be made from the heater supply of the transmitter. The circuit shown is a half-wave tripler operating from the 6.3 volt heater line. SR1, SR2, and SR3 are low voltage silicon rectifiers. Usually the filtering is adequate at point X. If more filtering is desired, R2 and C4 can be added. The output should be between 20 and 30 volts. If a higher voltage is desired, taking the ac off a 10 or 12 volt winding, if one is available, will raise the voltage to approximately

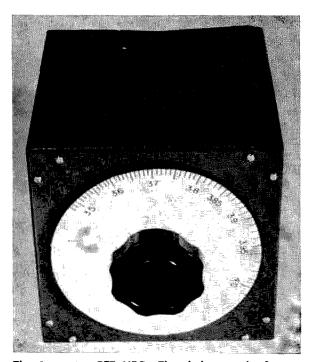


50 volts. Other uses for this supply include: bias for linears, bias for class AB1 and AB2 modulators, power for transistorized stages, etc. The supply can be used to deliver quite a bit of current, probably a few hundred milliamperes. It has good regulation and can be used for bias in stages where grid current is drawn, such as class B modulators, etc. The total cost for the supply should not exceed \$3 or \$4, and can be built for considerably less if some of the parts are in the junkbox.

. . . Larry Levy WA2INM

An FET VFO for 80 Meters

One of the big advantages of the field effect transistor oscillator is that it does not appreciably load down the tuned circuit. If you take a very close look at the circuit Q versus frequency stability curve you'll find that highly stable oscillators are coincident with high Q tanks. With the relatively low impedances encountered with the bipolar transistor', circuit loading is a severe problem which seriously affects frequency stability. In addition, the element capacitance of the bipolar device is very



The 80 meter FET VFO. The dial is made from a National AVD-250 planetary drive; the scale is printed on a paper disc which is glued to a 4 inch aluminum disc. The drive mechanism is on the rear of the panel; the aluminum disc is attached by means of screws and 1/4 inch spacers.

complex, varying with voltage, temperature and current. It is difficult to predict exactly what a given device will do because the rate of change of capacitance is a function of the bias level, and varies from device to device. On the other hand, the capacitance of the FET is almost completely unaffected by the source current, and the factors that influence FET capacitances always increase with temperature. Since the properly designed FET oscillator always has a positive temperature coefficient it is relatively easy to compensate.

The complex capacitance of the bipolar device has both negative and positive temperature coefficients, and for wide excursions in temperature, bipolar transistor oscillators are very difficult to compensate. Never the less, transistors inherently generate very little heat, and in amateur applications this difficulty is often not apparent. I can remember spending three weeks of continuous labor trying to compensate a 3 MHz oscillator that was to be used on one of our space vehicles; the transistors finally had to be changed before a stable unit was obtained.

An example of the frequency variance with temperature of two oscillators, one with an FET and one with a 2N918 bipolar transistor is shown in Fig. 1. Note that whereas

1. The bipolar transistor refers to conventional junction transistors made up of P-N junctions at the emitter, base and collector. In these transistors the current through the junction consists of both electrons and holes (absence of electrons). Because there are two types of current carriers (electrons and holes), these devices are referred to as "bipolar". On the other hand, the field effect transistor is a "unipolar" device because the current carriers are either electrons or holes, depending on whether it is an N- or P-channel device.

the frequency of the FET circuit decreases in a somewhat linear manner, the frequency of the bipolar oscillator first increases and then decreases. The negative temperature coefficient of capacitance dominates when the frequency increases and the positive coefficient as the frequency decreases. This type of curve obviously can not be compensated with a temperature sensitive capacitor in the tank circuit. It is also apparent from this graph that the bipolar circuit has a larger drift in frequency for a given change in temperature over most of the range. In many cases the ham oscillator is operated within the temperature range at the crest of the frequency curve where these undesired effects go unnoticed.

In the VFO described in this article. FET's are used in the oscillator and buffer stages and a bipolar transistor is used in the power output stage. The oscillator itself is a conventional series-tuned Colpitts or Clapp circuit with large silver mica capacitors providing the necessary feedback. The large value of these capacitors tends to swamp out any changes of capacitance within the device itself. The frequency drift of this unit was so small (probably because it was operated at room temperature near no vacuum tube heat generators) that no temperature compensation was required. most cases no compensation should be necessary, but if thermal drift is a problem, a negative temperature coefficient capacitor may be added in parallel with the 50 pF tuning capacitor as shown by the dotted lines in Fig. 2. In the event this compensating capacitor is required, the 75 pF capacitor should be reduced by a like amount.

Since a compact unit was desired, toroidal coils were used to maintain high Q without massive air wound inductors. Since there is virtually no field around a toroidal inductor, they may be placed near other objects in the circuit without affecting their Q. Sometimes this low amount of external field can be a problem because it's difficult to couple a grid dipper to the circuit to find out its resonant frequency. In addition, toroids are quite susceptible to 60 hertz ham pickup, and this is accentuated by the high impedance FET, so care must be taken to shield the circuit properly. In the author's case the hum was completely eliminated when the circuitry was mounted in a metal box.

To reduce loading on the oscillator stage, an FET source follower is used as an un-

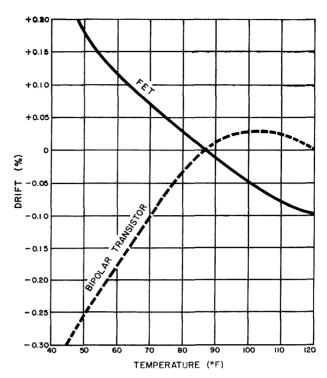
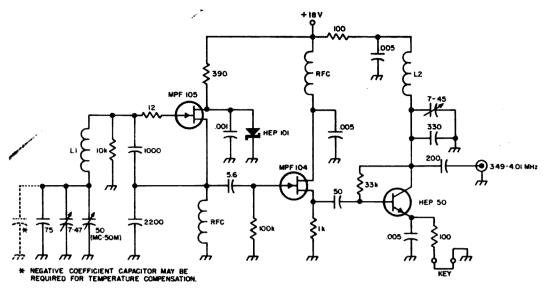


Fig. 1. Typical drift characteristics of FET and bipolar oscillators. This graph is based on a starting point of 30° C (86° F) and shows that the bipolar transistor has both negative and positive temperature characteristics while the FET capacitance has a positive temperature coefficient (causing the frequency to go down).

tuned buffer stage. The low value of coupling capacitance, 5.6 pF, serves to further reduce the loading on the oscillator. To eliminate any possiblie pulling or resonance effects, no tuned circuit is used in the buffer stage. The stage shown in the schematic exhibits extremely high input impedance and is a very effective isolator; when the output stage is keyed, there is no perceptible change in the rf voltage across the oscillator tank and the frequency remains rock stable.

The stability of the supply voltage to the osicllator is maintained by the 400 milliwatt, 9 volt zener diode (HEP 101) across the drain to ground. With the circuit constants shown, the voltage on the drain of the MPF 105 field effect transistor remains within 1% of the Zener voltage as the supply voltage varies from 13 to 25 volts.

The output stage uses a low cost silicon transistor in a conventional class C rf power amplifier circuit. At 4 MHz this stage has about 25 dB gain and provides 2.0 volts RMS output; this is more than sufficient to drive most transmitters. If the second harmonic at 7 MHz is desired, it is recommended that another HEP 50 stage be added



LI 53 TURNS NO. 28 ON 0.68" TOROID (AMI-TRON T-68-2) L2 27 TURNS NO 26 ON 0.68" TOROID (AMI-TRON T-68-2)

Fig. 2. The RFC's used in the FET 80 meter VFO are miniature 1 mH units available from J. W. Miller. The oscillator and output stage as shown here will run continuously. To key the output, remove the jumper marked "key" and connect the two terminals to your key. The two toroids are available postpaid anywhere in the U.S.A. for \$1.00 from Ami-Tron Associates, 12033 Otsego Street, North Hollywood, California 91607.

as a doubler. In the original model of this VFO the final stage was operated straight through on 80 meters and as a doubler for the higher bands. Although there was sufficient drive on 40 meters, there was not enough output on 20, 15 and 10. In fact, at the higher frequencies, the transmitter operated at the resonant frequency of the

Interior of the 80 meter VFO. The FET oscillator and buffer are in front of the shield, the HEP 50 output stage to the rear. The planetary drive is attached to the front panel with spacers. The screws and spacers which hold the dial pass through a 11/4 inch hole in the panel.

doubler tank (or its harmonic) and refused to be varied by the FET oscillator!

In this VFO all the components were mounted on a 1/8 inch sheet of micarta 31/2 inches wide and 5½ inches long. Soldering terminals were provided by drilling holes in the micarta with a number 42 drill and installing Vector pins (Vector T9.4). This meth d is very rigid mechanically and is easy to duplicate. A narrow strip of thin copper was mounted in the center of the micarta terminal board to provide a common ground for the circuitry. At the front of the board a Hammarlund MC-50M variable capacitor was mounted with the copper strip between it and the board. Except for the toroids, all the components were mounted by simply soldering them to the Vector terminals. By placing the body of the component next to the board and by using short leads, almost all vibration and its effects were eliminated. In fact, the completed unit can be slammed down on the bench with no perceptible change in frequency.

When winding the toroids, the turns should be spaced to completely fill up the circumference of the core. In this way maximum Q is obtained. After the toroids are wound, a little polystyrene Q-dope will hold the turns in place. The completed toroids are mounted to the board with $\frac{3}{16}$ inch flat head nylon screws that came in a nylon

screw assortment from the local hardware emporium. If you can't find any nylon screws, brass screws and fiber washers will work as well.

The frequency of the oscillator is set to the proper range with the 47 pF trimmer capacitor. With the variable capacitor plates fully meshed, set the oscillator frequency to about 3480 kHz with the trimmer; when the variable is fully open, the output frequency should be approximately 4020 kHz. If a full 500 kHz range cannot be obtained, decrease the value of the 75 pF shunting capacitor to the next lowest value (68 pF) and try it again. If you want to reduce the frequency coverage, increase the value of the 75 pF capacitor. The power output stage is adjusted for maximum output at 3750 kHz.

Although this unit was designed specifically for 80 meters, it may be used on other frequency ranges by simply changing the

number of turns on the toroid coils. Remember that the center frequency of the desired range is set with the inductance; the frequency spread is controlled by the size of the 75 pF shunting capacitor. In some cases a little juggling back and forth between the capacitor and inductor may be required to get the desired results, but it is not difficult nor time consuming.

Conventional bipolar transistors have eliminated many of the problems in stable VFO design, but they still have several minor disadvantages. The field effect transistor virtually eliminates these disadvantages and combines the low power and low heat of the bipolar device with the high impedance and predictable element capacitance characteristics of the vacuum tube. This VFO has provided such extremely stable results on 80 meters that an 8 MHz unit is under construction for use on six and two.

... W1DTY

Thermistors

We normally think of the lowly resistor as just that and only a load for a tube or transistor, a voltage dividing device, or a voltage dropping device. Modern science has provided to us with several exotic gadgets in the form of resistors with very special characteristics.

The most common of these is the temperature dependent resistor, better known as the thermistor. One of the most prevalent uses for the thermistor is in the audio circuits of the transistor radio where it limits the current as the temperature rises and thus prevents thermal run away. Many of them are used in ultra sensitive thermometers operating over a very narrow range. They can be made so small that in laboratories they are imbedded under the skin of animals to keep a constant check on body temperature. Others have been used to check wind velocity. Here two are used. A small voltage is applied to both so that they heat up. One is placed in the wind stream and the other is protected from the wind. Of course the one in the wind will cool down just as you cool your coffee by blowing on it. Measuring the current difference from one to the other will tell how hard the wind blows.

Another type, not as well known, is voltage dependent resistor or varistor. These

also come in many sizes and shapes. The TV repair boys have run into these where they are used for stabilizing the line deflection against voltage fluctuations, tube ageing, etc. They are also necessary in automatic synchronization circuits.

Varistors are used in great quantities for spark suppression and contact protection where the resistor acts to reduce voltage build-up and subsequent sparking across relay contacts.

Another use of varistors is voltage control. They cannot do the job of the fancy tube type or zener diodes but for the size and price they do give a high degree of stabilization.

Still another special resistor is the light dependent resistor. Actually this is a type of photo cell, one that does not generate electricity when exposed to light but only changes its resistance. These cells are usually made with a layer of compressed and sintered cadmium sulfide. Their resistance will range from 100 ohms in strong light to 100,000,000 in total darkness. The spectral sensitivity is fantastic, ranging from visable light to a good way into the infrared range. The peak sensitivity is at 6800 angstrom which is the center of the visable red.

. . . Ralph Hanna W8QUR

Tube Symptom Troubleshooting

Here are some useful hints to help you fix your inoperative gear.

Troubleshooting procedures in volving tubes naturally cover equipment involved in any ham interest, including ATV. This article contains a general accumulation of suggestions based on experience I have had in repairing electronic equipment under pressure which invariably leads to work routines that cut away as much lost motion as possible. Whether you are in a hurry to repair something or not, however, any clues furnished by faulty equipment which you correctly interpret and therefore avoid following false leads makes you a better troubleshooter. I know you probably check tubes early in the routine but how do you check them? Are you getting the most out of each observation, each test, each substitution? Any check you make 'just to see what happens' is aimless and although it will probably get the equipment fixed it isn't likely to contribute new information to make it easier the next time. Here are some clew furnished by tubes you may not be aware of:

1. Gassy Tube: The blue glow is not necessarily bad. If it wanders around aimlessly in the envelope like in a smoke-filled room, that's bad. Small, bright patches of blue are normal. They are also useful troubleshooting guides since they indicate a functioning tube that is being driven. For example, observe the action of an audio power output tube or a horizontal sweep output tube with an without drive. Watch these blue patches ignite with the tube operating and go out when the tube is disabled or drive removed.

2. Nosiy tube. You tap or rock the tube and the speaker emits noise. So you pull the tube, put in a new one, and the noise stops so the old tube was no good. Not necessarily. Pulling out the old and pushing in the new probably cleaned the dirty socket contacts. Put the old one back in just for the heck of it—you probably don't really need the new one and you have saved face and money.

3. Microphonic tube. Two causes for this

but one is an unnatural cause; rapping on the tube envelop to "check" it. Quit doing that. My experience includes a stereo system that was checked for every conceivable thing because of low frequency distortion and it was only a howling 12AX7. Moral here is, automatically blame tubes for everything because they are often to blame and the're easier to get to. I think it possible for new tubes and very old ones to be equally suspect. Manufacturers believe that a tube that survives the 90 day warranty will have a long life. Tension of grid wires causes the frame-grid tube to be prime microphonic candidate.

4. Red plates do not necessarily mean the tube is ruined or at fault. You are familiar with the usual maladjustments that cause excess plate dissipation in a transmitter. Are you familiar with the series B+ circuit? If an overload occurs in the low B+, the audio output tube is overworked and turns red: but the fault is not in the tube and seldom damages it. A tv horizontal output tube turns red if drive is lost so check the horizontal oscillator. In a color set, the high-voltage regulator tube fails. These are all examples of a fault indicated by one tube but caused by another tube or component.

5. Tube shields. You do replace all tube shields don't you? Are you sure that they are well seated and grounded. A good way to inject a signal into a tube is to connect the signal to the tube shield and then pull the shield up so that it doesn't touch ground. Using the same reasoning, an ungrounded shield can cause more grief than a missing shield. Manufacturer's got so tired of missing shields that they developed one that won't come off. The top portion is turned counterclockwise and pushed down. Hopefully, the top portion is pulled up and locked in place after service is rendered. If adding a shield cures a problem, be suspicious. Here is an example: By adding a shield in a ratio detector circuit, sound distortion was eliminated. However, the shield really added a reactance that should have been added by adjusting the sound transformer. Of course, we are speaking of manufactured and proven equipment in this instance—not experimental work.

- 6. Filament dead so tube is dead because putting in a new tube cured it. Also, maybe not so. If the tube has a base, crimp the filament pins with a sidecutter. Hardworking tubes like the 5U4 get pretty hot and the solder can granulate. Then again, it may not have been soldered well in manufacture and electrolysis has finally insulated the connection. Try it—what have you got to lose? By the wey, if the tube socket pins get that hot, better resolder them, too.
- 7. Clever trick. Look into glass envelopes now and then and try to interpret abnormal indications. Suppose a technician sees the 6V6 screen glowing and correctly surmises that the audio output transformer is open, causing the screen to dissipate far above normal. Didn't need a meter, a speaker, bench work, substitute tubes, etc., to solve that one.
- 8. Cracked envelope. You should always perform a visual inspection of tubes before pulling them lest you cut yourself on cracked glass. A cracked envelope will often show a white flare somewhere on the glass. Even if you don't cut yourself, it's a nusiance to pick bits of glass out of the socket well. Might be a good idea to buy one of the inexpensive tube pullers and save your fingers.
- 9. Heater cathode leakage. A television provides more clues than a radio. It causes 60-hertz hum or one black bar or the pix tube. The filter problem (120-hertz hum) causes two black bars. If the hum gets into the sweep circuits instead of the video, check for leakage in deflection tubes and the pix tube will provide evidence in the form of picture bending or poor color convergence. (This stuff goes on. We've got to try and make this brief but a book could be written on the things a tube will tell you). The intensitity of the hum in the audio channel provides a clue because the closer the defective tube is to the antenna the more amplification the hum receives. When you build equipment, take the precautions given you by the tube manufacturer concerning tube orientation since this often relates to the plane of the filament.
 - 10. Mystery tubes. If you can't read the

tube type on the glass envelope, breathe on it as you would when cleaning your spectacles. If this doesn't work, put the tube in the refrigerator ice compartment. Often, frost will form in a manner that will outline the disappearing legend. The interior of the tube is frequently distinctive enough to determine the type. The 6AV6 and 6AL5 are easy ones.

- 11. Suffix letter A. The letter "A" following tube type often means the manufacturer has improved a tube; sometimes because the original was a stinker. Sometimes because of a specific change such as delayed warm-up characteristics. Two examples are: the 6U8 and 6U8A and the 6AQ5 and 6AQ5A.
- 12. Tubes are not spark plugs. Don't put in a round of new ones at regular intervals to give the set that "old zing". Too many circuits still detune and must be adjusted after tube replacement in wholesale lots. Anyway, that's guess work.
- 13. The best tube tester is a new tube. If you want to see filaments go and microphonics develop, take out all the tubes and brown-bag'em to the tube tester and back again. Dynamic testing of a tube is worthwhile. The short test is a ghastly thing. Some people hammer the daylights out of the poor tube and I don't know if they are vehemently trying to prove or disprove that a short circuit exists. A good gadget is a soft rubber ball mounted on a dowel rod. Tap the tube gently with it or tap the chassis near the tube (a little harder) with the same tool.
- 14. Tube substitutes. Let's be suspicious except in emergencies. Unless your vessel is marooned and Captian Video asks you to raise the space rangers, it is better to get the original type but hardly ever necessary to specify the original manufacturer of the equipment. You should use the same type if a tube manufacturer has his name on it to avoid the thing called divided responsibility. For example, a GE serviceman is reluctant to replace an inwarrantly RCA tube without charge and you are not prepared to take warranty tubes to two or more places if they should fail. An example of tubes that are erroneously listed as substitutes are: 6BC8, 6BQ7A, and 6BK7. Get the original type since interchanging these can bring you an alignment job. At the other extreme, I once used a 6K6 to temporarily substitute for a 6X5: had to chop

off unused pins and the control grid performed well as one of the rectifier plates. It was an emergency. A 6AV6 will always substitute for a 6AT6 if you want a little more sound.

15. Tube plate caps. Easy does it! Don't make extra work for yourself. Take the connector off very carefully. It will take you about one hour of cross-eyed work to replace the socket on a picture tube if you pull the plug off too quickly. But you should pull these things off and make sure there is continuity. The hot plate cap of a transmitting tube, highpower PA tube, horizontal deflection tube, etc., often renders the solder joint useless. Sometimes, the connection works but high-voltage causes a constant arc that continues to deteriorate the joint and produces hard-to-trace interfering signals. If the heat has also hardened the lead, perhaps you should replace both the cap and the lead.

16. Tube swapping. Good idea if the tubes are of the same type. A transmitter may have two or three tubes of the same type for low level audio, speech amplifier. vox amplifier, etc. By swapping tubes you can probably trace your problem by generating a new one. There are limits to this and fringe benefits, too. If a tube is marginal and operating in a critical circuit, swap it with a like tube in a circuit which is less critical. Often this will not only disclose the trouble but allow you to use the marginal tube a little longer. Tubes in the microphone amplifier stage may be slightly microphonic or low gain but work well in a higher level stage. When troubleshooting television, swap sweep circuit tubes to track down problems but don't get carried away in rf and video circuits.

17. Filament continuity. The rule of thumb is this: If the tube has seven pins, check between pins 3 and 4. If nine pins, check between 4 and 5 and 9. All do not use pin 9 (such as 6BQ7A) but 4 and 5 are always used. For octal sockets, usually pins 2 and 7. Rectifiers (like 5U4) are pins 2 and 8. If 2 and 7 don't work, check 7 and 8 (like 6SI7).

18. Tube reinsertion. Before you pull a keyless tube from a socket that is obviously hard to reach or see, remember the trouble you had the last time trying to get it back in. The simple way is to remove the tube without allowing it to rotate in the hand until you get it into the light. Then, remem-

ber its orientation with respect to the chassis. Someday, when you have the chassis out, do this: Take a narrow strip of masking tape and stick it to the side of the tube and allow it to extend down and attach to the shield socket and then cut it at the top of the shield socket. Your sense of feel will tell you when the edges of the cut ends are aligned for subsequent replacement. Of course, you can often see the socket shield but not down into the socket: in this case the tape works very well.

Big bonus hint: Once upon a time, the tube manufacturers built a clever tube box for any kind of little tube but they didn't tell anyone how to use it. I suggest a game. Give a boxed tube to a friend and ask him to remove the tube. He will either open one end and pick away at it to get the tube out, or he will open both ends and push the tube out. Either way is illegal. If you'll look in the box, you'll see two cardboard wedges anchored at the box corners. If you invert the box over your hand and push at these corners of the box (using thumb and forefinger, naturally) where the wedges are attached, the wedges will expand and allow the tube to fall into your hand. It's a little thing but it looks so, well-professionalyou know what I mean?

The ATV ham shouldn't use the family tv for a monitor. Especially, for video input, it's necessary to add a switch and jack to "jeep" the instrument which will void the warranty. It isn't a question of whether the serviceman likes it or not since you obviously fix your own tv—don't you? I could give you a list of televisions that can't be "jeeped" anyway: especially color sets. The alternative is to get an old dog from the tv shop or garage sale and fix it up; also applying the suggestions on tube troubleshooting I've given you plus these hints particularly applicable to tv.

Don't fuss with tubes and replace the tube rectifier with diodes to get enough width and then discover the yoke isn't pushed all the way forward. Adjust the ion trap (if any) for brightest raster with the brightness control at maximum. Do not use the ion trap to get rid of neck shadows at the expense of brightness. Use the centering adjustments for that. You may be surprised to find B+ in an old set too high instead of too low. This can happen if a number of original tubes are still in use since they have all declined and the total current drain is less

than the "no life" value. If you aggrevate this situation by putting in diodes for rectifiers, expect some other breakdowns such as electrolytics. Don't borrow trouble. When you get a used tv, inspect the kinescope faceplate for deep scratches which are a dangerous invitation to implosion. Especially since I'm afraid you're going to let it run in the shack without its cabinet—a bad practice. When you get the television running for the first time, the picture may indicate poor emission. It might be caused by a long period of idleness so put on the picture tube brightener and then take it off again after a while—don't use it if you don't have to

More on the tv which has sat idle a long while. The electrolytics can be reformed first and possible failures can be avoided. To do this, apply the line voltage through a Variac for while with the B+ output disconnected from the load and input not too low to endanger the power transformer. This suggestion is for us cheapskates. Others prefer to apply higher than normal voltage and blow what's going to blow—tch! tch! If you need a replacement picture tube, investigate the possibility of a substitute at lower cost. The years following manufacturer of your set finds new types and the

cost of types fluctuating up and down according to the number manufactured. The majority of instruments use the "21 inch" tube with the portable sizes following close behind and the sizes above 21 inch being the poorest investment.

Look out for those dangerous metal picture tubes since they bite everywhere. They don't kill you but you break your neck jumping out of the way. If you get corona from these, it will usually be around the bell (forward of the yoke). To cure this, take the picture tube out and wash it thoroughly with soap and water, dry, and apply a good wax all around the bell. When you wash glass envelopes, be careful with the acquadag coating which forms one condenser plate for high voltage.

Lastly, don't improve the tv with changes in tube types for better signal-to-noise and such unless you got a good plan; like the lone ranger. It's usually easier to preamplify outboard and the 432-MHz converter can use the preamplifier as its if amplifier.

You know, I think the most embarassing thing of all is to get deep into chassis troubleshooting and then discover a tube under there—yech!

. . . WAØNEA

Faraday Shields

A simple device that for some reason has fallen into oblivion is the Faraday screen or shield. It is still important enough to the FCC that it is included in the Tech and General class license exam.

All of you, I am sure, know that a Faraday screen looks like a big comb with one common wire with a lot of other wires running out from it and not connected on the other end.

The Faraday shield eliminates capacitive coupling between coils. The desired signal should be inductively coupled because this is tuned to the desired frequency, be it the antenna or another coil. The capacitive coupling does not see anything except a mass of metal and any frequency present can be transferred. This can cause all kinds of stray stuff to show up on the feed lines and especially some of the harmonics and even some of the subharmonics in the case of a transmitter with multiplier stages. All

of these things can cause or add to the TVI problem.

The Faraday screen prevents the electric field from one coil reaching the other, but has no effect on the magnetic field. This is because of the open-ended wires. No current can flow in an open wire and current must flow to give effective magnetic shielding with non-magnetic material.

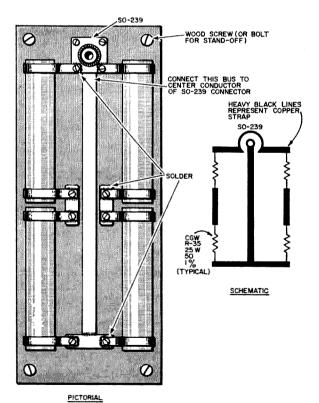
Faraday screens can be made quite easy and if you have harmonic troubles, and don't know what to do next, why don't you try one? The screen should be a bit longer than the coils to be coupled. Wire size? No. 18 is about the largest that should be used. Space the wires about the same as the diameter of the wire. One good way to make one would be to glue a bunch of wires to a thin piece of plastic. This would give excellent support and a couple of brackets would make an easy job of mounting. If you have a printed board making kit, it would be simple to draw a bunch of lines with the etch stop pen, then etch away the copper between the lines.

. . . Ralph Hanna W8QUR

A \$2 200-Watt Dummy Load

Stop creating QRM. Test into an inexpensive dummy load.

Everybody tells the radio amateur, "You ought to feed all of your test transmissions into a dummy antenna, and not radiate needless interference." For a starter does he go out and buy a Bird Electronics 1,000 watt rf watt meter, Model 694 for only \$365.00? Works very nicely throughout the 2-30 MHz range, according to the spec's. Or maybe the Waters dummy load for \$135—a very nice item—wish I had one. Or perhaps the Heathkit Cantenna for only 10 bucks, plus postage and four quarts of oil. All of the above items are certainly reasonably priced, according to one's needs; but



Details of the Meshna-special dummy load. The resistors are 35¢ apiece. The board is 4 x 10", and preferably fiber glass or bakelite. The resistors are supported by $\frac{1}{2}$ " or longer spacers.

what do you say to the ham with 150 or 200 watts input and only a couple of bucks to spare? Cheer up, help is on the way . . . "Noninductive, late style 50 ohm, 25 watt resistors, 35c," said the ad. So I bought four of these from Meshna . . . four of these in series-parallel connection should give 50 ohms effective resistance, with 100 watts of heat dissipating ability. Anyone can see from our most elementary drawing that you don't need to be an electronic genius to duplicate this very simple item. The only additional cost was for an Amphenol type SO-239 fitting and the surplus Fiberglass board on which the whole assembly is mounted. If you feel really "sharp" you might choose to run the center conductor in the form of a three-wire bus, or maybe a copper strip. This is supposed to cut down on "stray inductance" and make the dummy load resistance closer to 100% non-reactive. I checked out the final product on a Heathkit DX-100 transmitter and found that the SWR was fairly low on 40 meters, reading 1.05 to 1 on a Knight SWR Meter. This rose to 1.2 to 1 on the 21-MHz band. Maybe the resistors are non-inductive at 2 or 3 MHz, but they seem to become more reactive as the frequency increases. But for two bucks, you can't ask for perfection, can you?

Maybe not, but you can try. I swiped a few feet of the wife's Reynolds-Wrap from the kitchen. I made up some experimental coils from the aluminum strip, approximately 1 inch wide, and shaped the coils to resemble the resistors. With the trusty griddip oscillator, they resonated close to 68 MHz when shunted with a presision 100 pF. condenser. The coil was connected directly to the capacitor terminals—this comes too close to channel 4 in our household—so the experiments were not long in progress! The "ball-park" figure of 0.05 µH of inductance for the resistor is reasonably close. The cal-

culated value of L for a typical resistor was $0.03~\mu\text{H}$. They are "spiral-cut" and the pitch varies slightly in production. Probably this explains the slight reactive quality of the dummy load resistors.

It might be possible, with a little experimenting and a different physical layout, to come up with a cancellation of most of these effects, and possibly bring the SWR down to 1.1 to 1 throughout the HF amateur

bands. We stopped short of this goal, since the load as it presently stands does an excellent job on all the ham bands 80 thru 15 meters. It should be possible to feed more power into the "dummy" if you place it outdoors on a cold winter's night. As it stands, you can feed the rf output from a 250 or 300 watt rig, key-down half the time, without additional cooling.

. . W2OLU

Tired of Dead Batteries?

Don't get caught with your battery down. Install an extra battery with little trouble.

Shortly after I first started mobile operation I experienced a pitfall that happens sooner or later being stranded with a dead battery (and sometimes in awkward locations).

I started to carry an extra battery but it was a nuisance using jumber cables and I was never sure how much charge was left in the extra battery. So I decided to hook it up in parallel with the main car battery.

I read some of the articles in the ham publications and most of them used complicated hookups with lots of relays to install the extra battery. One author even went so far as to use a relay to disconnect the extra battery when starting the car motor. To me this all seemed ridiculous.

Figure one shows the simple hookup I used. All the radio equipment (and some extra lights that I use a lot for camping and extended periods of mobile relay operation at night) are connected to the extra battery side of the relay.

With the relay coil being connected to the ignition switch several bonus features are to be had, namely:

- 1. Operation with the motor off drains only the extra battery, leaving the mean battery to start the motor.
- 2. Both batteries supply current to start the motor, a big bonus on those cold winter mornings.
- 3. Both batteries are charged automatical-

*Ignition switches vary . . . use your ingenuity to get the results desired. In the later cars it might be best to connect to the wire going to the spark coil.

- ly. No special adjustments to the voltage regulator, etc., are needed.
- 4. Any thing left turned on overnight will drain only one battery.
- 5. When a battery "goes west" of old age (which seems to happen anytime or anywhere) the other battery will start the car and get you home.

I find it best to keep the best battery in the front (factory installed position). This system has worked out perfect for me in three cars and I am now installing it in my fourth car.

It is a great comfort to know I won't be stranded during extended mobile especially in Civil Air Patrol operation where it is common to operate continuously in one spot for several days. In this type of operation I operate usually two frequencies at the same time and also monitor other services as the situation might require.

For the price of a battery and a relay (much cheaper then a alternator system and in many ways even better) you can have a lot of freedom from worry about the "power source" in your car.

. . . W3WVA

CONTACT TO RADIO EQUIP

CAPACITY
SO-SOA

MAIN

D BATTERY

TO CHARGING

TO IGNITION

TO CHARGING

TO IGNITION

W3WUA's simple solution to the problem of dead batteries.

The Easy Way to Decibels

One of the most often used yet little understood terms in amateur radio is the decibel, commonly known as the dB. Articles and introductions to this not-too-complex topic are generally presented with the formula:

$$dB = 10 \log \frac{V_s}{V_1}$$
 for power and

$$dB = 20 \log \frac{P_a}{P_i}$$
 for voltage

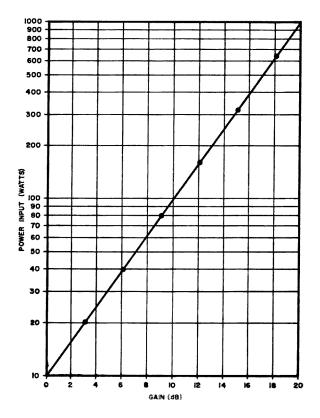
Each has its use in amateur radio. However, the amateur not versed in mathematics and logarithms, when confronted with these formulas, usually backs off. Most hams, therefore, are content with the knowledge that an increase in the number of decibels is desirable and that a loss in the number of decibels is not.

This knowledge suffices for all practical purposes. However, considering the many times decibels are used in the operation of a station, it behooves the amateur to become more familiar with this elusive term. The amateur may consider increasing the power of his station or changing antennas. How many decibels will this change represent? Will it pay to increase transmitter power or install a more efficient antenna system? This article will help to answer these questions without the use of complex mathematics.

Decibels as such are not an absolute quantity. They refer to a change. This change expresses ratio whether it be current, voltage, or power. The ratio means nothing until some reference level is established. Once the reference is set this reference is considered zero (0) dB. For example, some communications engineers may use 6 milliwatts (.006 watt) as reference

while others will use 1 milliwatt (.001 watt). The reference level or zero dB, when used in amateur radio, is whatever the amateur starts with.

For the purpose of illustration lets assume Joe Ham has a 10 watt rig which is operating under ideal conditions (no losses). It must be realized that there are always losses. However, for the purpose of facilitating the understanding of decibels all conditions will be considered ideal. The power input to the final (the 10 watts) is the reference level or zero db. Any station changes to increase power will be referred to this starting power. If the station was running a 100 or 1000 watt transmitter, this would be the 0 dB or refer-





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SPECIFICATIONS:

- Measures 23/4" x 4" x 7" (excluding lens and connectors).
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- Tested at 10° to 125° F.
- Advanced circuitry utilizing 35 semi-conductors most of which are silicon.
- Field effect Input circuit for minimum video noise.
- Resolution guaranteed to exceed standards set by 525 line TV receivers.
- RF output 30,000 microvolts adjustable for channels 2 to 6.
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ence level.

Any contemplated change in the transmitter power will result in a change in decibels or a change in the power ratio. Joe ham decides to increase his power from 10 watts to 20 watts. What will the result be in decibels? Referring to Fig. 1 will disclose that the increase will be 3 dB. Observe that to obtain an additional 3 dB gain the 20 watts must be increased to 40 watts. Therefore, an important point to remember is: each time the power is doubled the gain is increased by 3 dB. Conversely a 3 dB loss reduces the power by ½. Knowing these facts any multiple of 3 dB can be calculated. Accordingly, let's see how this works out for an arbitrary value of 15 dB.

dB gain watts	0 10	$\frac{3}{20}$	6 40	9 80	$\begin{array}{c} 12 \\ 160 \end{array}$	15 3 2 0
dB loss	0	3	6	9	12	15
	10	5	2.5	1.25	0.625	0.3125

In order to extend our ability to calculate dB's it will be advantageous to review some basic arthmatic. When a number is multiplied by 10 you affix a zero to the number. Multiplying by 100 you affix two zeros, etc. This is known as shifting the decimal. Dividing by any multiple of 10 moves the decimal in the opposite direction. The ability to shift the decimal is all that is required to be able to calculate decibels in multiples of 10.

Calculating decibels in multiples of 10 is simple if you consider the reference as 0 dB, if it is desired to determine the increase in power for 10 dBs we've changed the reference 0 to 10 by putting the digit 1 before the zero. Essentially this digit (1) tells you to add 1 zero to the reference. Therefore, the 10 watts with a 10 dB increase becomes 100 watts. For 20 dB the digit before the 0 is 2. This digit (2) tells you to add 2 zeros. The 10 watts with a 20 dB gain will become 1000 watts. In order to clarify this let's utilize this information to make a chart.

dB gain 0 10 20 30 40 50 watts 10 100 1000 10000 100000 100000

To consider losses. It is best to consider that the digits before the zero indicates the number of places the decimal must be moved to the right. Observe the chart below.

dB loss 0 10 20 30 40 50 watts 10. 1.0 0.1 0.01 0.001 0.0001

Places deci-

mal moves 0 1 2 3 4 5

Thus far we are able to calculate decibels in multiples of 3 dB and 10 dB. Combining these two facts with addition and subtraction we are now able to determine the gain or loss for any number of decibels. To ascertain that we do, we'll find the value for any number of decibels between 10 and 20 still using the original 10 watts as zero reference. Starting with 10 dB gain adds a zero to our reference, increasing the 10 watts to 100 watts. Each additional 3 dB gain doubles the power.

Decibels 0 10 13 16 19 watts 10 100 200 400 800

Now starting at 20 dB the 10 watts with two zeros becomes 1000 watts. Each 3 dB reduces the power ½.

Decibels 0 20 17 14 11 watts 10 1000 500 250 125

The only values we have not determined are values of decibels for 12, 15, and 18. These values are multiples of 3 and can be calculated by utilizing the method de-

scribed previously.

The practical application of decibels in terms of power, can now dictate the advantages or disadvantages of station changes. Increasing transmitter power is a one way street. The old adage; you can't work what you can't hear is applicable. Therefore, when looking for db gains; travel the two way street via the antennas. Improving antenna capabilities increases the number of decibels in both the transmitted power and the received signal.

When antenna gain is specified by the manufacturer, the gain is based on what the beam will do in comparison to a dipole under the same conditions. If a beam rated at 8 dB gain is replaced by one having 15 dB the gain is 7 dB. Stacking antennas increases the gain 3 dB. Raising the antenna an additional 30 feet will result in a 10 dB gain. These facts are presented so that you can start using this method of calculating decibels in terms of power the easy way.

. . . K3PXT

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Ed Marriner, W6BLZ 528 Colima Street La Jolla, California

The Highflyer

An All-Band SSB-CW Receiver

This article is about a home-brew ham band receiver covering the 80-40 20-15 and 10 meter bands in 200 kHz tuning steps. Before discussing the receiver a few reflective thoughts are presented on the idea of home-brew construction in general.

Most amateurs should be able to build a receiver if they have the time, a few instruments and tools. Picking circuits to use out of the handbooks may not always work for a specific application, and it may be necessary to try several circuits before finding one that works right.

Home constructed gear probably has some faults but if you really take a close look at most manufactured gear there will be oscillator harmonics across spots in the dial, images and signals feeding through from other bands. A ham can do a comparable job and have a lot of fun building which should be part of our hobby.

Some people spend all of their time building intricate model ships, airplanes or play cards. I spend my time building impossible ham gear. Perhaps the urge to build is the desire to do something creative instead of just yakking on the microphone for a change. The fallacy that you have to be experienced to work out ham gear is wrong. Anyone can gain enough experience if they just

72 73 MAGAZINE

work at building for a while, but they must build and try various circuits. Sometimes it helps to keep notes on the circuits tried, but I am always too busy to keep notes and find myself making the same mistakes over again. Fortunately I am clever at filling up chassis holes. After months of building and the unit is finished I may never turn it on again, but after completing this receiver I can't wait to get home and turn it on to marvel how well it works and that I was able to build it. It is a fine feeling that is not present turning on a manufactured receiver. Visitors stop in to listen, and this way hams from all over the world at one time or another come by the shack.

Besides personal contact one way amateurs can exchange circuits and transmit or expand his knowledge from generation to generation is through magazine articles. If amateurs don't take advantage of this and continue their mad pace to buy all manufactured equipment, our old concept of ham radio will have changed. Fortunately we have 73 Magazine as a medium to pass on information that is not staff written. One can read and does not always have to build the item in the article to gain some new idea. With this thought, the following receiver article is presented, and I hope someone has the

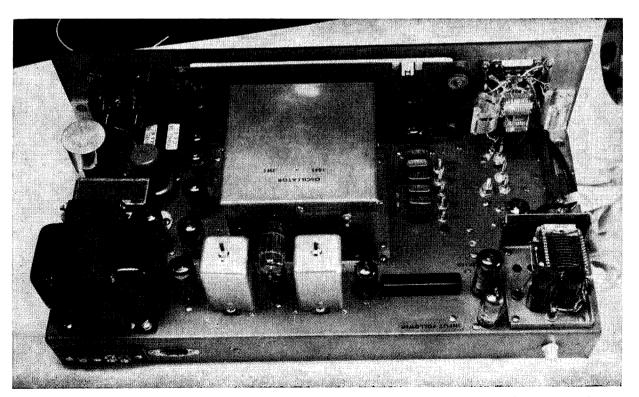
time and a few bucks to buy the parts and give it a try.

Theory

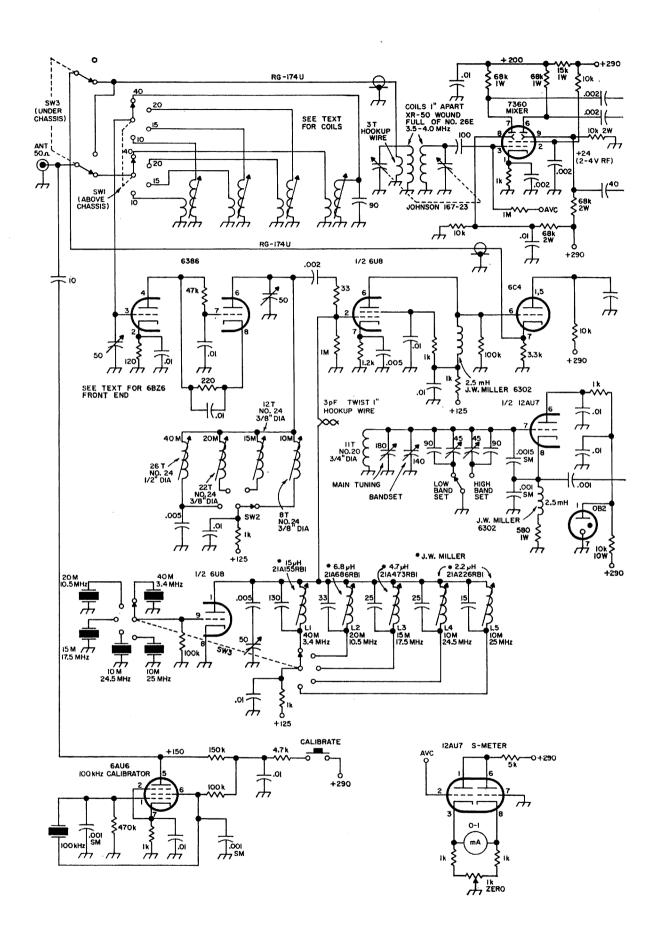
Basically this receiver is a simple 80 meter receiver into which converters are fed for the HF bands. On 80 meters the panel switch feeds the 52-ohm coax antenna input directly into the 7360 mixer input tube through two tuned circuits which are loosely coupled. This is necessary along with the shielding of these coils to prevent signals 455 kHz away, such as fishing boat frequencies, from coming in on the 80 meter ham band. A VFO signal of 3045-3345 kHz and 3345-3545 Khz is injected into the 7360 mixer tube. The mixed output of this tube is 455 kHz and is coupled directly into the Collins mechanical band pass filter. The signal is then amplified by two stages of if amplification controlled by AVC; then the amplified signal is detected in a product detector and audio amplified.

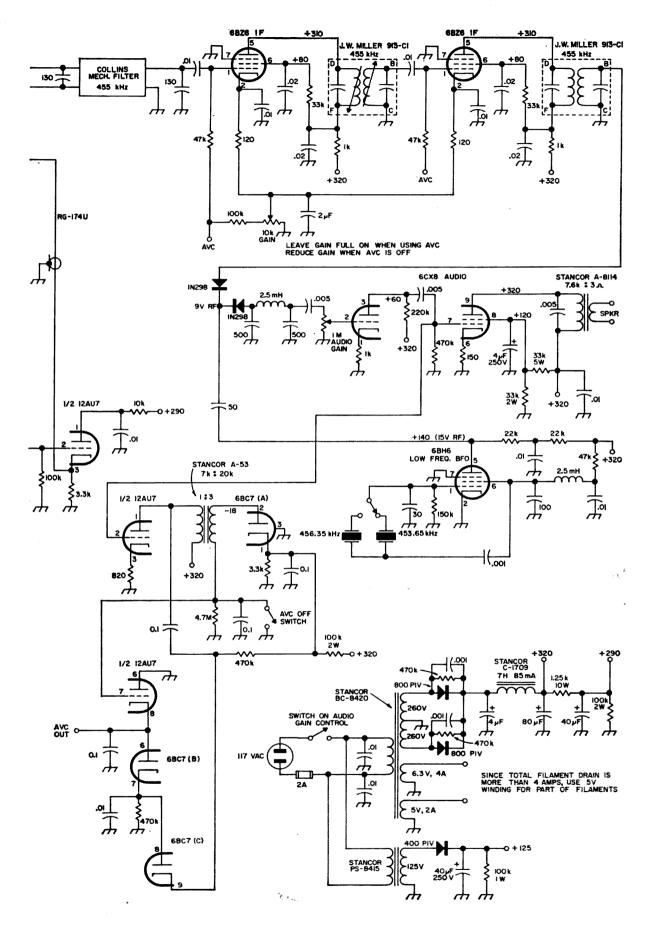
Construction

On the 40 20 15 and 10 meter bands a crystal-controlled converter preceded by a cascode rf stage feds into the 80 meter receiver via a cathode follower which matches to the high impedance output of the 6U8



Back view of the receiver showing input on the right side, mechanical filter, if strip, and power transformer on the left. The VFO is enclosed in the large box in the center of the receiver.





converter plate circuit. The forty meter band tuning starts at 3600 kHz, this idea was used to keep from having to use a 3500 kHz crystal which would be annoying if it was operating on its harmonic of 7000 kHz during tuning.

The AVC uses the Luick system of audio amplified fast attack AVC, one of the best circuits for receiver design.

The most expensive parts are the Collins Mechanical filter, number F455-21-6626, a 2.1 kHz bandwidth filter costing \$26 obtained directly from Mr. B. Cornes, Component Sales, Collins Radio Co., 19700 Jamboree Rd. P.O. Box C, Newport Beach, Calif. and the Eddystone dial #898 ordered direct from Mr. F. N. D. Harris, British Radio Electronics Ltd. 1742 Wisconsin Ave. NW, Washington, D.C. These two pieces are the heart of the receiver; after making the decision to purchase them the next thing is to buy a 8 x 17 x 2 inches California Chassis type A-109 and a PA-14, 8% x 19 inch panel. I cut my panel down to 6½ inches high by 17 inches long for a more pleasing appearance. A few shields are necessary and 16 gauge aluminum can be bent in a vise with two blocks of wood or maybe you know someone with a hobby brake or can get a metal shop to do it for you. LMB boxes can also be sawed up to get shields. Once the major portion of the holes have been punched a professional appearance can be given the chassis by dipping it in chemical dye obtained from a chemical supply house under the trade name Oakite metal dve. The chassis is first cleaned with lacquer thinner and dipped in lye water which is warm. This cleans the metal. This is washed off and dipped in Oakite bright dip and washed again. The chassis is then put in the Oakite gold metal dye for 15 minutes and washed off. Plastic containers for dipping can be bought in the Super-Markets.

Metal working requires a few tools. A % inch, a % inch, and a 1% inch Greenlee punch are almost necessities. A clear drill for 4-40 and 6-32 screws and a % inch, % inch and % inch bit for metal are also needed.

Probably the first electrical circuit to build is the power supply so that voltages will be available to check out the circuits as they are built. The VFO should be built on the chassis next so that you will know how much available space is left to lay out the parts. Next after the VFO, wire the audio stage and check it out, then the if system. The grid return to the if's can be grounded to test it out since the AVC has not yet been built. Along with the audio and if put in the diode detector and wire up the low frequency crystal oscillator for the BFO. When this is finished a 455 kHz signal can be fed into the if front end and detected and if's peaked up. If the mechanical filter has not arrived that spot can be jumped out with a .005 µF capacitor between the 7360 mixer and the if tube for testing. After the 7360 has been wired in the AVC can be built, leaving the VHF converters until the receiver is operating correctly on 80 meters.

Power supply

The load on the 6.3 V, 4 amp filament winding is heavy and some of the tubes such as the crystal oscillators and others can be run off the 5 V winding without any bad effect. The extreme drain on this transformer might warrant using a larger one but as an assist to the HF isolation the drain was eased by using a 125 volt 15 mA instrument transformer for the converter and rf stage. Stancor type PS-8415 was used here.

Two 400 piv diodes were put in series for rectifiers in each arm of the transformer. They are cheaper than diodes with higher piv's. To keep transients from puncturing the diode rectifier a .001 µF disc ceramic capacitor is placed across each diode rectifier along with a 470 k ½ watt resistor. For complete elimination of hum a 4 μF condenser was used as an input filter before the filter choke. It was necessary with a large loud speaker with good low frequency response to keep it free from hum. Power for the VFO is obtained from a 105 volt OB2 gas regulator. The series resistor should be adjusted so that at least 10 to 15 mA does it.

Audio system

The audio system uses one tube which gives plenty of audio gain. If the audio is weak is is not the fault of this stage which is a 6CX8 triode and a pentode in one bottle. The screen voltage should be held constant at not over 150 volts by a voltage divider. Our voltage was 120 volts. A .005 μ F capacitor is placed across the

primary of the audio transformer to prevent self oscillation from building up and damaging the audio transformer winding insulation or to prevent arcing from occuring across the tube socket pins.

By now you will need some knobs to adjust controls. The fancy knobs used on this set were Davies type 1913 black knobs with white indicator lines. They will have to be ordered from Littrell Western Sales, Inc., P.O. Box 23645, 3121 East Twelfth St, Los Angeles, Calif. 90023, attn. Mr. M. Morita. Radio parts stores do not seem to stock anything out of the ordinary and it's worth the effort to get these and make the receiver look better.

The triode portion of the tube normally uses a 150-ohm resistor but in this instance there was so much gain the current was reduced by inserting a 1000 ohm resistor.

Shielded wire such as RG-174U was used to wire the gain control on the panel. Just ahead of the triode tube is a filter made up of two 500 pF capacitors and a 2.5 mH rfc. This filter prevents any 455 kHz signal from feeding into the audio system. A 68 k resistor could be used in place of the choke but the cut-off characteristics of the filter will be changed slightly.

Product detector

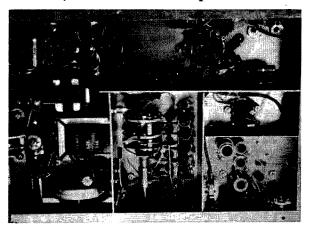
Of all the various product detector circuits tried this two diode circuit performs as well as any, however, germanium diodes must be used. Just any diode won't work. The diode used has to have a lot of leakage to prevent charging up and blocking. The 1N295 or 1N67A are common ones used in this circuit. For loud signals proper mixing is secured in these diodes with 5 to 12 volts of rf from the crystal oscillator. Anything under 5 volts will sound distorted if a strong signal is being received but will sound okay on weak signals. Injection was measured by using a signal generator and varying the diode injection voltage and listening to its performance at the various voltages for weak and strong signals. This rf voltage was measured with an rf probe in conjunction with a Heathkit VTVM.

The if strip

The first thing to do when building the if strip is to open up the if can and squeeze the coils to within ½ inch of each other. This operation is not recommended by the J. W. Miller Co. because the coil now be-

comes overcoupled and might be a reflection on their product if it gets into wrong hands. I reasoned that I needed the extra gain to make up for the loss in the mechanical filter, and I did not want to add another if tube. Since the selectivity was obtained in the filter it was felt that the ultimate in selectivity was not needed from the if cans. Squeezing the coils together is difficult to accomplish without damaging them. Bill Courtney at the J. W. Miller Co. would rather wind the coils for you than have you damage them. If you already have coils, take a razor blade and scrape the glyptol from each side of them on the top coil only where it is glued to the fibre form. Now with a camel hair brush paint dope thinner around the base of the coil to soften up the cement under the wire. Next place a piece of % inch thick wood between the coil by first drilling out a %" hole and sawing the block in two parts so that it fits snuggly around the fibre tube. Take another piece of wood with a 1/4 inch hole and slip it over the fibre tube after the slug has been removed. With a quick snap the coil should slide up against the wood between them leaving the coils 1/2 inch apart. Do not try this process without using the spacer because the wire will come out from inside of the coil.

Many hams have trouble trying to build an *if* amplifier without oscillation or regeneration taking place. First all parts should be returned to one ground lug on each *if* tube, although it never seems to help the problem. In most cases a 22 k or 47 k resistor can be put across the winding of the *if* transformer to stop oscillation or



Bottom view of the receiver showing the converter output coils in the lower right hand corner. The box in the middle contains the crystal switch and coils. To the left is the converter power supply.

by tapping down on the secondary winding for the grid. Most military receivers do this and the Miller has tapped coils for this purpose. Many commercial builders increase the 6BZ6 cathode resistor to 120 ohms to cut down on the gain. I found building this receiver the stage is absolutely cool by reducing the series resistor to the AVC line to 47k in conjunction with squeezing the coils together which lowers the "Q" grid is looking into. No resistors were needed across the coils and we were quite happy to find no regeneration when peaking the if cans in this receiver. Good decoupling with 1 k resistors and .01 µF capacitors in the supply leads also help to isolate feedback.

7360 mixer stage

This tube was chosen because it eliminates the need for an rf stage and takes large input signals. It is linear and performs mixing by switching between two output plates operating in push pull and is inherently balanced against the input signal frequencies. The oscillator injection voltage can be anything from 1 to 10 volts. The tube does have some critical aspects in transmitters where the accellerator voltage changing can unbalance the carrier. In receivers, this is not critical except that proper voltages should be used. There must be 175 volts on the screen or accellerator and 20 to 25 volts on the deflection plates. The main supply to the tube should be set at 200 volts to give 150 volts on the plates. The voltage actually came out a little higher in this receiver. The tube couples easily into the mechanical filter via the .002 µF capacitors.

Reference data on the cross-modulation and overload characterics can be found in QST.¹

VFO injection to the mixer is not critical. One to five volts is satisfactory. Since there is no rf tube ahead of the 7360 adjacent signals 455 kHz away in the marine band might feed in if they are not attenuated by a good shielded front end coil. 80 meters is the only band we have to worry about this because the image is 3.5 MHz away using the converters on the other bands.

To gain this good selectivity on 80 meters a large coil could be used, but that takes up a lot of room. It was found two XR-50 National slug forms wound full with number 26 wire and tuned with a split stator capacitor make a good filter. The coils were placed adjacent to each other and peaked up to the capacitor and moved away from each other to about one inch where the double hump effect went away and left a nice sharp tuned circuit. The image should be down 60 dB. The coils were placed in a box to prevent any pick up of signals by themselves. Any split-stator capacitor could be used but the E. F. Johnson butterfly type dual #167-23, 50 pF each section took up little space. It was necessary to shunt another 40 pF across each section so that it would tune the 80 meter band, which can be set in the middle of the condenser range by adjusting the slugs to maximum signal strength.

AVC was used on the 7360 to good advantage since it limits the signal going into the mechanical filter, which would over load and ring if the signal peaks were too high.

AVC system

The receiver should be tried out before hooking on the AVC system by grounding all of the if and 7360 grid resistors. Once the AVC system is hooked on there should be a negative AVC voltage of 0-20 volts. The Luick AVC system was chosen for this receiver after having used several systems in other receivers. It works the best for fast attack and slow decay. The hold-up time is set by the 0.1 μ F capacitor and 4.7 M Ω resistor. If this resistor is made smaller VOX operated SSB stations will make the receiver pump and sound funny. This value can be lowered for CW but so far there has been no need for it.

The AVC voltage is taken off the product detector and is amplified by a triode tube, then rectified and passed on through another diode to charge up the storage capacitor, a 0.1 µF capacitor, which stays charged until discharged to ground by the other triode tube. A strong audio signal provides a negative voltage of 0-20 to control the if's and 7360 tubes. When there is no audio signal coming, the grid of the triode goes positive and allows the charge on the capacitor to leak off to ground. This grid control is also effected by the

¹ A New Approach to Receiver Front-End Design, p. 31 Sept. 1963 QST.

Cross-Modulation in the 7360, p. 58 June 1964 QST.

The Squire-Sanders SS-1R Receiver, p. 54 May 1964 QST.

⁷³⁶⁰ Mixers in the 75A-4 p. 18 July 1964 QST.

0.1 μ F and the 4.7 M Ω resistor. For faster or slower leak off the value of this resistor can be increased or decreased, changing the time the voltage will be stored and the 0.1 μ F holds the triode off. A discussion of this circuit is in the ARRL Handbook, if you have trouble.

"S" Meter

The "S" meter can be taken off from the AVC line and it will be a measure of the AVC voltage. Zero level can be set with no signal and by adjusting the balance potentiometer. The scale reading was adjusted for a strong signal at R-9 by changing the value of the cathode resistors. Maximum reading can be set by either adjusting these cathode resistors or by changing to higher gain tubes such as the 12AT7, or 12AX7 if the 12AU7 has to low a gain and you don't want to fuss with the resistors. It is important to use no grid return resistor on the tube where the meter is attached to the AVC line or it will upset the time constant of the AVC action. Thus vou will note no grid resistor is used in this circuit.

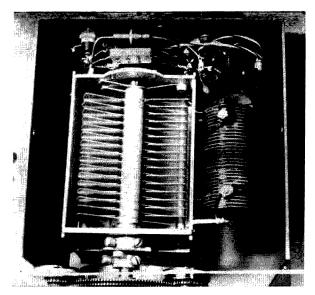
Tuning of a signal produces a negative voltage on the AVC line which causes currents in the cathodes of the "S" meter amplifier to unbalance the circuit. The meter will read the unbalanced or difference voltage. The resistor in series with the tube plates can also be adjusted larger or smaller depending on the meter readings.

The "S" meter is a Lafayette Model 99-2514, 0-1 mA with illumination. Instructions for lamp connection is inside the box.

VFO

The VFO oscillator tunes both 3045 to 3265 kHz and 3315 to 3545 kHz, using the surplus ARC-5, 180 pF capacitor. Tuning barely covers the band. The ham bands are covered in two steps of about 250 kHz each. The oscillator was switched with a three position switch. The third section uses no padders and covers 4000 to 4200 kHz. The trimmer on band two was set so that the dial matched 3720 on zero and 3500 on band one.

A cathode follower was used after the VFO to separate any loading effect on the oscillator. All signals are carried via RG-174U coax. The coil was bolted to the capacitor so that there would be no mechanical motion. The tube is mounted in a horizontal



The inside of the VFO box assembly.

position on the back of the box. Calibration should be done with the cover bolted in place. With an LM frequency meter the calibration is easy. Otherwise someone on the air with a Collins transmitter could give calibration marks or surplus crystals could be used for check points. The rf output to the mixer can be varied by changing the 40 pF capacitor in series with the cathode follower output. Anything between 2-4 or six volts will be satisfactory for injection. When the VFO was finished the coil was doped with Q dope, although, the wire was wound in grooves. Air-Dux bulk coil could be used if no fibre forms are available.

This circuit is so swamped with high capacitance that the stability of the circuit is very good, and there does not seem to be any drift problem noticed. Use silver mica capacitors in the tuned circuits in conjunction with the air capacitors.

Low frequency oscillator

Many low frequency crystal oscillator circuits were tried using surplus crystals ground to 453.650 and 456.350 kHz. The only circuit which worked satisfactorily is the one shown in the schematic. Perhaps the wave form on the oscillator plate with no tuned circuit leaves much to be desired for a perfect sine wave, however, the frequency is correct, and it is satisfactory for the product detector injection.

Sluggish low frequency crystals need a large rf choke in the screen lead, and most circuits use a 60 mH choke. This circuit worked with a 2.5 mH choke taking up less

space. Sometimes the 30 pF capacitor from grid to ground may have to be varied to obtain oscillator but not the 100 pF from

the screen to ground.

New crystals can be bought from Mr. P. M. Freeman at International Crystal, 18 North Lee St., Oklahoma City, Okla., ground to 453.650 and 456.350 exactly but they cost \$8.00 each. It is important to have these crystals as close to these values as possible so that the band-width of the receiver is 2.7 kHz wide at the 20 dB down points. Otherwise the voice signals will sound distorted.

The other solution for the proper crystal is to buy surplus crystals and edge-sand them down to frequency. JAN*, which advertises in 73 Magazine, sells these crystals for 50 cents each. A channel 45 and a channel 329 will work but sound a little funny. If you're brave, buy a handful and sand them down, tuning the receiver until they sound good. The best way would be to check the frequency with a counter.

Changing the frequency can be done as follows:

Put a piece of fine emery paper on a flat surface and tape it down. Place the crystal in the left hand holding the prongs with the fingers of the left hand, and holding the crystal itself with tweezers in the right hand. Draw the crystal edge toward you moving both hands together making a scratch about five inches long. Drag the crystal across the paper about ten times and it will move it about 600 Hz higher in frequency. This process is very touchy and if the tweezer slips, the crystal will twist and break the fine wire, it might pay to take the time and make a wooden holder from a clothes pin or two pieces of wood, but it can be done.

The following are surplus crystal channels:

Channel 326 - 452.777 Channel 45 - 453.707 Channel 327 - 453.166 Channel 46 - 455.555 Channel 329 - 456.944 Channel 47 - 457.407

I suppose other methods could be used to vary the crystal frequency. Shunting capacitors across the crystal never worked very good and did not change the frequency enough. With patience you can get the Channel 327 and Channel 46 on the spot.

You can get an idea what a crystal off frequency sounds like by plugging in some of the above mentioned crystals.

The HF Crystal Oscillator

It is recommended that the International crystals of .01% tolerence be used in this oscillator so that the dial calibration will be on the mark. International FA-9 crystal fits into a FT-243 crystal socket. All of the crystals will oscillate in a standard triode oscillator with a tuned plate tank, although the output may fall off slightly at the higher frequencies. It is difficult to specify the exact value of the slug coil and tuning capacitor to use with each coil because the lead length will be different used by each constructor. Tuning is critical. These coils can be grid-dipped with the meter when they are all in place and then adjusted for capacity after applying power and noting where the slug comes to rest. The slug should be set just back of maximum output because the oscillation will drop out if too near maximum tuning. An rf probe can be used to peak up these coils or a full scale meter section of the grid-dipper. Using the probe a test point can be put in the chassis and coupled to the coils with a 10 pF capacitor to make it easy.

	Ctal	Coll J. W. Miller	by Silver Mica
	Crystal		
40 meters	3200	21A155RBI—15 μH	130 pF
20 meters	10,500	$21A68RBI - 6.8 \mu H$	33 pF
15 meters	17,500	21A473RBI— 4.7 μH	25 pH
10 meters	24.500	21A226RBI— 2.2 μH	15 pF
10 meters	25,000	21A226RBI— 2.2 μH	15 pF

VHF Converter

You can wind your own coils using #26 wire if desired. XR-50 forms are nice if you have room.

This section which looked to be the most simple turned out to be the most difficult part to make work properly. The first try used a 7360 but it was necessary without the rf stage and output coils to use a high Q coil circuit. The coil being so large picked up 80 meter signals like an antenna and fed in the 80 meter signals on all bands. To prevent this an rf stage was added and the 7360 replaced with a 6U8 mixer. Reducing the size of the coils and shielding them stopped the pick-up and prevented oscillation from occuring. To further prevent coupling a separate power supply was used for this section and it was needed any-

way because of the overloaded power transformer on the rest of the receiver.

On the upper deck of the receiver was installed a switch to change the input coils to the rf stage. Oscillations could not be stopped when all of the switches were ganged together. The coil dimensions are as follows:

40 Meters-34 inch dia., 15 turns, Link, 6 turns. Air-Dux Bulk Coil #632

20 Meters-34 inch dia., 11 turns, Link, 4 turns. Air-Dux Bulk Coil #616

15 Meters—% inch dia., 8 turns. Link, 3 turns. Air Dux Bulk Coil #516

10 Meters—5% inch dia., 6 turns. Air Dux Bulk Coil #516 6 turns. Link, 2

These coils were mounted on five lug terminals, with the ten meter coil just soldered across the Centralab ceramic wafer switch, a double pole six position switch, Type PA3.

The output coils of the cascode converter are the grid input to the converter, and are separated from the converter grid by a shield. The 33 ohm resistor in series with the grid helps prevent overloading.

The output coils are as follows:

40 meters: 26 turns en. #24 wire wound on a

½ inch slug coil form.
20 meters: 22 turns en. #24 wire wound on a % inch slug coil form.

15 meters: 12 turns en. #24 wire wound on a

% inch slug coil form.

10 nieters: 8 turns en. #24 wire wound on a % inch siug coil form.

Coils are all grid dipped and adjusted in the circuit

The XR-50 coil forms can be used if desired but the smaller coil forms fit better taking up less space. The 50 pF variable capacitor completes it circuit through a .005 μF capacitor between the bottom of the coils and ground lug. The switch for these coils is located underneath the chassis. This switch is used by itself, the other half is not used. The switch for shifting the converter output to the cathode follower is under the chassis and is part of the crystal switching switch.

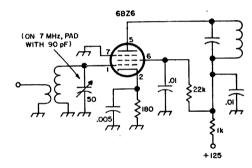
RF Stage

The rf stage is one of the most difficult things to build in a receiver. Any type of coupling between the grid and plate brings on oscillation. The rf stage should not oscillate when the antenna is disconnected from the set, and the input and output tuning capacitors are tuned. For complete separation the antenna input coils should be mounted on top of the chassis in a box if possible while the output coils are mounted underneath. The grid should have a piece of tin cut from a coffee can around the

grid pin, which can be soldered to the center shield of the socket. Put the feedthrough insulator right at the grid pin. Shield the output coils from the grid if possible.

Generally 40 meters will oscillate while the other bands are clean. This is due to insufficient capacitance tuning on that coil. A 90 pF capacitor was soldered across the coil and turns peeled off so that the variable would peak it to 40 meters. This is done with the antenna on because it will add some capacitance to the tuned circuit and which will be different than when it is taken

The 6386 cascode tube is expensive and may not be desired by some constructors. An alternate circuit using the 6BZ6 is shown. The coils are the same. Actually on the lower bands no difference was really noted between the two circuits as far as sensitivity or noise was concerned. The 6BZ6 gives a little more gain which is needed on the ten meter band.



Alternate of amplifier that can be used in place of the 6386 tube. The same coil arrangement can be used. Put a shield around the grid.

Conclusion

The average amateur with a few tools and a VTVM and a grid-dip meter can have a lot of fun building this receiver. The receiver seems to work about as well as almost any on the market although it may take a few more switches to accomplish the band changing.

If you are in the area on your vacation and want to listen for yourself stop by. Just come in the back gate, and don't mind that madman running around in the backyard in shorts, barefoot, no shirt, hair uncombed, glasses down on the end of his nose, and waving a soldering iron. That's me, off on another construction project.

. . . W6BLZ

Geometric Circuit Design

A simple way to design electronic circuits is with geometry. This method avoids complicated math, yet is very versatile.

Over some years I have developed and have been using a new technique in circuit design. It is mainly graphic being based on geometry and avoids the abstractions found in complex algebra and many other forms of mathematics. The technique is deceptively simple and is based on only five basic con-

Henry, ex-W3AUE, is an electronic project engineer for Fairchild Hiller. He was licensed in the '20's.

cepts. Three of them are probably already known by circuit design people at every level. The other two are new and are needed to complete the design picture. These basic layouts are shown in Fig. 1.

At (a) two resistors are added in series. The same can be done with two or more inductive reactances on the XL axis or with two or more capacitive reactances on the Xc axis. At (b) we have the fimiliar parallelogram which shows the impedance formed by an inductive reactance X1 and a resitor R1 in series. Likewise the same can be done with

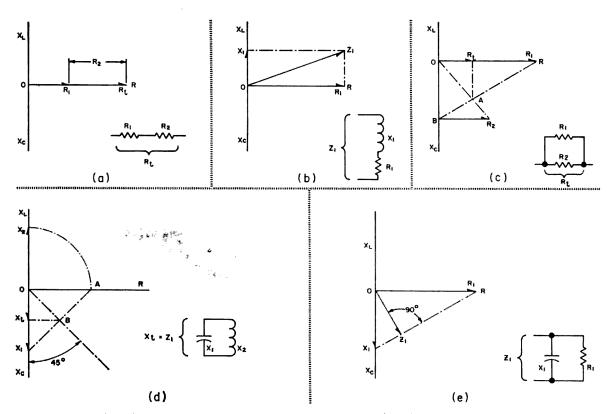


Fig. 1. Examples of geometric circuit design. Resistances are plotted on the horizontal axis marked R, capacitive reactances on the lower vertical axis, and inductive reactances on the upper vertical axis. (a) shows two resistors in series. (b) shows the impedance formed by a resistors and inductance is series. (c) shows the resistance of two parallel resistors. (d) illustrates a capacitor and coil in parallel. (e) shows a resistor and capacitor in parallel.

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any Xc ar R or in fact any two impedances in series. The total value of any two resistors in parallel or any two like reactances can be found by the means shown in (c) of Fig. 1. While this one shows the R axis the same can be done with either other axis. Distance O-B is arbitrary and intercept A of the diagonal is projected up to find Rt. In Fig. 1 (d) a simple method of finding the parallel value of two opposite reactances. With the value of X2 as a radius, an arc is laid out to the R axis. At the intercept A a straight line is connected to XI. A 45 degree line is extended from the origin (O) as shown. At intercept B a line is projected horizontally to the X axis locating the resultant total reactance Xt. In any case the arc is constructed from the larger of the two reactances. Finally in Fig. 1 (e) there is shown the resulting impedance of R1 in parallel with X1. Here again this can be done similarly with any R and XL values.

It must be realized that any of these techniques can be worked in reverse that is if we have Rt and R2 in Fig. 1 (a) we can find R1. Likewise at (b) if we know Z1 and R1 we can easily find X1. In any case if we have any two we can find the third by these

simple geometric layouts.

Armed with these concepts we can now "jump off at the deep end of the pool" and emerge with meaningfull answers. Let's design a band pass "T" type filter to match 50 ohms to 200 ohms. Its schematic and layout is shown in Fig. 2. A scale of 50 ohms per centimeter* was used here and Rl is thus 1 cm long and R2 being 200 ohms is 4 cm long from the origin. We select X1 arbitrary and find Z1 immediately (see Fig. 1 (b). Z1 has equivalent shunt components Xh and Rh (See Fig. 1 (e). Since X2 depends on the value of X3 we cannot find it before we find X3 which we can find. Since Z1 and Z2 have the same equivalent shunt resistance Rh, a locus semicircle O to Rh has been drawn. This passes through both Z1 and Z2. Z2 is established simply by projecting vertically up from R2. See Fig. 1 (b). Now Z2 has equivalent components Xt and Rh which are in parallel. Again refer to Fig. 1 (e). Some reactance value X2 in shunt with Xt must form Xh. We find the value of X2 by projecting horizontally from Xh to the 45 degree line intercept B. We then project from Xt through B to A and draw an arc from A to

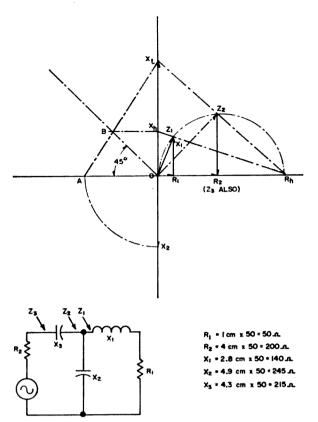


Fig. 2. Designing a band pass T filter to match 50 ohms to 200 ohms. The procedure is described in the text.

X2 about the origin. This establishes the value of X2. This geometry is performed on the left of the X axis to avoid confusion. This derives from Fig. 1 (d) working backwards. From the values Xt and Xh we have found X2

Continuing XI, X2, and X3 are measured in cm and multiplied by the scale factor (50 ohms pre cm). Values of each in ohms is shown in Fig. 2. If the design is for 27 MHz the component values are about 0.82µH for XI, 24 pF for X2 and 32 pF for X3. Components for any frequency desired can be found which will match these two resistances and deliver maximum power from one to the other.

Since we have a picture of all of the components and impedances in polar form it is possible to analyze or synthesize any complex circuit for phase shift, attenuation (voltage or current) and Q. With the value of Q we can determine the bandwidth.

The simplest way to match one transistor to another at a specified frequency is by means of an "L" filter. In Fig. 3 the schematic and layout are shown. Neglecting the distributed parameters we assume the in-

^{*}These drawings are reproduced ¼ size.

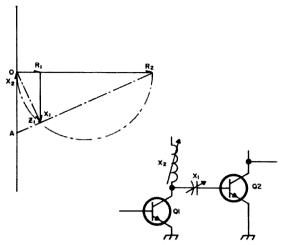


Fig. 3. Matching one transistor to another with an L filter.

put resistance of Q2 to be R1 and the output resistance of Q1 to be R2. These values must be found at the frequency desired. The locus circle with diameter O-R2 simplifies the construction of Z1 at right angles to the construction line R2-Z1, implementing the concept of Fig. 1 (e). In series with R1 we drop a perpendicular to the semicircle. This establishes Z1 that is the impedance looking from Q1 thru XI into the input of Q2. X2 extends upward from A to the origin. This is the reactance across R2 necessary to form Z1. Components can be evaluated as described above for 455 kHz or 50 MHz or any other frequency. Known distributed parameters are taken into account by adding them into the layout in the manner set forth in Fig. 1.

This technique can be extended to include the design or synthesis of delay lines transmission lines, "10" and "hi" pass filters, all coupling networks, and many mesh and bridge circuits.

. . Bradford

Transceive with the GSB-201

The manual on the GSB-201 suggests another relay to operate it on transceive. Here is a way to do it with but adding a small transformer and rewiring a few parts. Thrown in is a cut-off bias supply for the amplifier in standby.

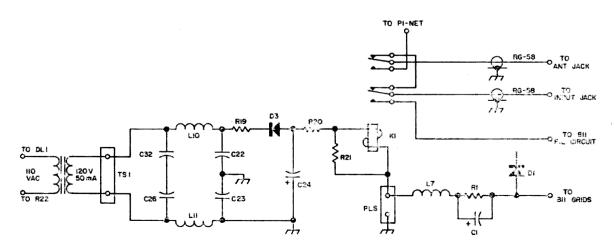
Modify the circuit as follows. Locate and reverse the D3 diode and C24 capacitor as shown. Remove the lead going to K1 from the junction of L11C23, C24. Ground the latter. Connect the lead going to K1 just removed to ungrounded side of PL5. Rewire K1 relay contacts as shown using R6G58 coax where needed. Add small transformer to circuit by connecting it to TS1 and primary to AC at DL1 and R22.

Be sure and put tape over TS1 on outside to prevent shock. Remove R21 only if you desire to speed up K1 operation. If this is done reduce value of C24.

Now we do all our switching by connecting relay contacts of transceiver to PL5. We find we have gained a built-in cut off bias supply. And by grounding this at PL5 we cause K1 to operate and cut amplifier into the cht. To disable amplifier and run transceiver only throw SI to off in amplifier.

Caution should be observed to keep leads short and well shielded. In my own amplifier I found no instability after this modification.

. Bruce Walther W9QAH



A Field Effect Transistor Converter for 10, 15 and 20 Meters

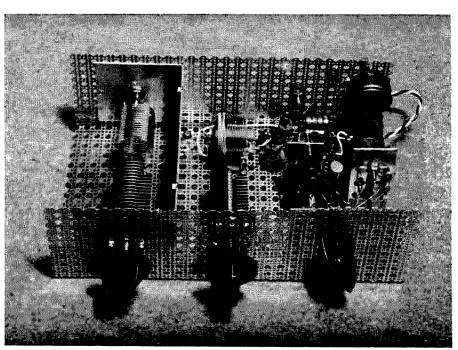
It is the author's goal to build a completely transistorized 10-160 Meter station. Lack of a low priced rf power transistor has postponed construction of the transmitter and, until recently, construction of the receiver was not attempted since it was felt that a vacuum tube front end was superior to any transistorized front end the author was capable of building. The availability of reasonably priced field effect transistors has changed the latter situation. With the high input impedance and almost perfect square-law transfer characteristic of the FET, the input circuit loading and susceptibility to cross modulation of a conventional transistor front end are easily avoided. Accordingly, the first step in building a receiver, designing and building a 10-20 meter crystal-controlled converter, was undertaken.

The converter schematic is shown in Fig.

1. Motorola 2N4224 FET's are used as the rf amplifier and mixer, while a bipolar 2N1180 is used as a transistor oscillator. A pair of Motorola MPF105's could probably be substituted for the 2N4224's, at a third of the cost, but this has not yet been tried.

The rf amplifier is designed to provide only enough gain to override any noise generated in the converter, so as to minimize susceptibility to cross modulation. This small amount of amplification, in conjunction with the sharp tuning characteristics of L₁-C₁ and L₂-C₂, yields a front end that is every bit the equal of its vacuum tube counterpart.

Mixer injection is accomplished by means of a "gimmick" capacitor connected to the mixer gate. Source injection was found to be satisfactory, but was not used because of the bandswitching problem it introduced: another switch section and a long lead to the mixer source were required. Source in-



Top view of the converter. Note that the input circuit is shielded. Photo by Chuck Marshall.

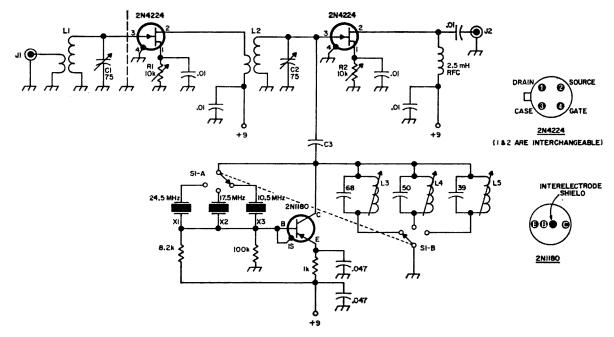


Fig. 1. Schematic diagram of the FET converter for 20, 15 and 10 meters.

jection would be preferable if local oscillator radiation proved to be a problem, since it places two FET's between the oscillator and antenna rather than one, as is the case when gate injection is used. (The reverse transfer capacitance of the 2N4224 is 2 pF compared to a grid-plate capacitance of 0.02 pF for the 6BZ6 pentode, a common rf amplifier.) A suitable cource injection circuit is shown in Fig 2 for those who may prefer it.

The oscillator circuit was borrowed from another article¹ and is conventional in design.

Adjustment

After the converter is completed, connect it to an antenna and an 80 Meter receiver. DO NOT CONNECT THE POWER SOURCE UNTIL ALL TRANSISTORS ARE IN THEIR SOCKETS. Set the bias pots, R₁ and R₂ to mid-range and place S₁ in the 20 meter position. Then adjust L₃, C₁, and C₂ for a peak in 20 meter signal strength. As the re-

Parts List

C3-Two 1-inch lengths of insulated hookup wire twisted together.

L4—Primary, 12 turn No. 20, 16 t.p.i., ¾-inch diam. (B&W 3011), Secondary, 3 turns No. 20, 16 t.p.i., ¾-inch diam. spaced 1 turn from primary.

L2—Primary, as L1, Secondary, 3½ turns insulated hookup wire wound on cold end of primary.

L3—35 turns No. 30 enam. wire, close-wound on ¼-inch

L₃—35 turns No. 30 enam. wire, close-wound on ¼-inch diam. iron-slug form (Miller 20A000RBI useable).

 L_4 -25 turns No. 30 enam. wire, close-wound on same type form as L_3 .

L5—15 turns No. 30 enam. wire, close-wound on same type form as Ls. ceiver is tuned across the band, C₁ and C₂ will have to be re-peaked every 25 kHz. or so. Place the converter in operation on 15 and 10 meters in a similar fashion. Adjust the bias pots for best converter operation, after which they may be replaced with fixed resistors or wired permanently into the circuit.

Results

The results to date have been pleasing. Although the converter has not seen much use on 10 meters, it appears to work well on that band. On 15 and 20 meters it easily

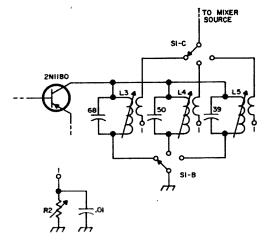


Fig. 2. Alternate circuit employing source injection. Coils L3, L4 and L5 are identical to those in Fig. 1, except that each has a three turn secondary.



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holds its own with the 6BZ6-6U8A converter in the ARRL Handbook² as regards cross modulation. The overall gain of the FET converter is slightly less than its vacuum tube counterpart, but turning up the receiver rf gain remedies that. Any signal that can be copied with the vacuum tube converter can be copied with the FET converter. . . . K6DOB

References

- 1. Harris, "Transistor High-Frequency Converters," QST, March, 1963.
- 2. "A Crystal Controlled Converter for 10, 15, and 10 Meters," The Radio Amateur's Handbook, 1962 through 1965 editions.

Sealing Coaxial Cable

After a coaxial line has been hooked up to an antenna, most hams wrap it with plastic electrical tape and spray it with lacquer to waterproof the cable and protect it from the weather. This method works quite well for a little while, but after several months exposure to heat, cold, rain and our polluted atmosphere, the plastic coating and tape deteriorate quite badly. Also, if the cable flexes in the wind, the tape has a tendency to pull away from the outer jacket. If you use Silastic Bathtub Caulk instead, the line will stay dry for long per.ods of time. This material is impervious to moisture and most contaminants and is very flexible. If the cable is cleaned with soap and water before the caulk is applied, it adheres very well and is nearly impossible to remove. It retains its characteristic under all extremes of temperature and even stays quite flexible in very cold temperatures, so it won't crack and peel. I don't have any idea what the terminal life of Silastic is. but it has not deteriorated at all on cables that I installed six months ago. I already had to replace peeling and cracked tape coverings applied to other cables at the same time.

. . . Jim Fisk W1DTY

*Registered trademark of Dow Corning Corporation. Midland, Michigan.

WWV on the Mohawk

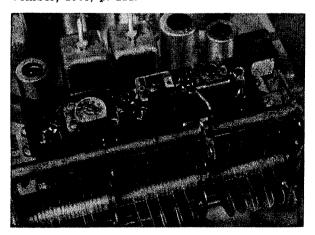
Mohawk owners who have remounted the crystal calibrator trimmer on the top of the chassis¹ may still have difficulty finding WWV at 10 MHz using the trimmers supplied with the kit. The trimmers have to be connected across the proper main tuning capacitor sections, a job further complicated by the rather small size of the trap door on the top of the cabinet. Another problem is that WWV reception on 10 MHz is unreliable under adverse propagation conditions.

A solution to the problem is a plug-in converter that allows reception of WWV at 5 MHz. Three trimmers are connected across the proper sections of the main tuning capacitor to tune the 40 meter band to 5 MHz. No modifications are made to the receiver itself.

A little investigation uncovers the fact that the stator sections of the main tuning capacitor in use on the 40 meter band are connected to three eyes in the ceramic insulators on top of the frame. These eyes are just about the right diameter to fit standard banana plugs.

The plugs are mounted on a 1½ x 4¾" piece of ¾" phenolic or Plexiglass. Drill the holes for three stud-mount banana plugs

¹ "Mohawk Tip," Giannotti, 73 Magazine, November, 1965, p. 121.



along one edge, spacing them 2" apart Mount the plugs and check the fit in the main tuning capacitor—do not use any force, the ceramic is rather fragile. You will find that the plugs are a loose fit in the holes, so carefully pry the leaves out to provide good contact and mechanical support.

The trimmer capacitors can be anything handy, but it is much easier to adjust the oscillator if a small ceramic trimmer is connected across a larger value fixed silver mica capacitor. The NPO ceramic trimmer does not drift and holds its setting even when the converter is knocking around in the desk drawer. The final setting of the oscillator capacitor was a total of 200 pF, measured on a capacitance bridge. The mixer and rf capacitances were 110 pF and 151 pF respectively. Choose your trimmers keeping these values in mind. This puts WWV on the 7.1 MHz dial calibration.

Mount the trimmers and fixed capacitors (if used) on the board and wire the unit. One side of each trimmer goes to each of the three banana plugs. The plug closest to the front panel is the oscillator, the next one is the mixer, and the last one is the rf section. Connect the other terminals together and connect a short flexible lead to this tie point. The clip is connected to the frame of the main tuning capacitor and serves as a ground return path for the three trimmers.

When the unit is complete, plug it in and tune the receiver to 7.1 MHz. If the trimmers were not preset it will be necessary to find 5 MHz. Tune a signal generator to 5 mc and adjust the oscillator trimmer until the signal is heard. Peak the mixer and rf trimmers. Now turn off the signal generator and tune for WWV. It should be nearby. Repeak the mixer and rf trimmers and the job is done. Now whenever you want to hear WWV merely tune to 7.1 MHz and plug in the converter.

. . . **K8KWQ**

High-Pass Receiving-Antenna Filters

Many of us have used a second rf stage, a preselector with tubes a passive tuned circuit ahead of a receiver, or tuned traps to eliminate unwanted signals. This has been with varying degrees of success. The traps probably have been the most effective where their single frequency does the job.

There remain some images in modern receivers, particularly at the second mixer. Also, there are spurious signals produced by one or more local broadcast stations causing a signal to appear at a false place in an amateur band. In my case, an open-wire telephone line crosses the property. It passes one broadcast station seven miles away, and two others about 18 miles away. The difference frequencies move amateur phones into the CW band. KP4CNN said that he had troubles with a transceiver, until he stopped the broadcast-station signals from going through the pi network to the grid of the first receiving tube.

In order to test rejection circuits for undesirable effects, I fed a signal generator into

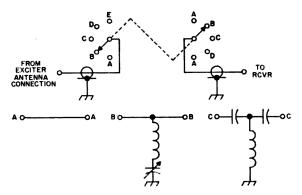


Fig. 1. A two-pole, multiple-circuit rotary switch for inserting various filters in receiving antenna line.

a cubical quad. Then I connected a receiver to a filter and to an 80-meter grounded antenna, trapped for 40 meters. Next time, I shall switch the antennas, for the long wire gave a mismatch for other frequencies, which appears to be the cause of a slight increase or decrease in receiver signal-plus-noise-tonoise ratio on 21 and 28 MHz. The quad in its simple unmatched configuration is useful for reasonably flat standing-wave ratio. However, it feeds a very wide range of frequencies into the receiver, including broadcast band, VLF and even audio (5 and 10 kHz) carrier systems. This pick-up in a quad is far greater than in a horizontal dipole or vagi with a suitable matching device.

Tuned circuits

In an attempt to improve everything at once, I tried a parallel-resonant tuned circuit mounted in a shield box. This used a link and a tap on the coil for 50-ohm input and output to the receiver and antenna. With it, the desired signals were reduced in strength and were strongest when the circuit was off resonance. This apparently corrected the standing wave reflected by the receiver toward the antenna. The rejection of off-resonance signals was not outstanding.

A pi-wound choke from the antenna lead to ground did not cause any loss of receiver sensitivity measured by SN/N ratio with and without the choke. A capacitor inserted between the choke and ground then could tune the series-resonant circuit to the broadcast band. Although this caused one broadcast station to disappear when tuned out, a station on some other frequency became louder. This also appears to be caused by the reactance of the circuit improving reception on

another frequency. Several of these traps probably could have been used to eliminate the three offending stations. This approach was not attractive because of the VLF and audio carriers on the telephone line.

High-pass filters

The next step was to insert a simple "T" high-pass filter in the antenna line, with a theoretical cut-off between the broadcast band and 3.5 MHz. Air Dux coils were tried first, using the inductance given in World Radio Laboratories' catalogs, and checked with a grid-dip oscillator. Convenient nomograms for this appear in the R.S.G.B. Data Reference Book, and in the Knightkit GDO assembly manual. Good performance also was obtained from small one-cent surplus chokes and a sack full of mica capacitors. It was convenient to include in the shield box a twopole rotary switch with a number of positions. Fig. 1 shows this, which provides connections for straight-through use for inserting a number of devices for comparison.

Filter A had one section. It was designed for a 50-ohm input and output, with a 2.6 MHz cut-off. It used two .0012 µF capacitors in series with the antenna and a 1.5 µH Air Dux coil between ground and the connection between the two capacitors. This attenuated signals a few unimportant decibels in the noisy 80-meter band, as shown in Fig. 2. This and all other filters with a cut-off below 3.5 MHz had an attentuation of 0.5 db or less at 7 MHz and at 14 MHz.

Filter B included a second section without a shield between coils, which should have been provided. The two series capacitors between sections were replaced with one capacitor of half the value. This two-section filter had no attentuation above 3.6 MHz, except for a loss of 4 dB at 21 MHz.

Filter C used a 2.5 μ H Air Dux coil, and two .0016 μ F capacitors with a cut-off of 2.0 MHz. This produced a gain in receiver SN/N ratio in most of the 80-meter band, and only a 1.0 dB loss at 21 MHz. For simplification, it is not included in the graph.

Filter D used a 2.0 µH miniature choke. This one had a large attentuation at 3.4 MHz, and gains in the mid-band region, disappearing at 4.0 MHz. It also had a slight gain of 0.5 dB at 7 MHz and 28 MHz, with a 1.0 dB loss at 21 Mc. It remains in use, although the increased rejection by a second section would be useful.

Later, in order to eliminate any signals

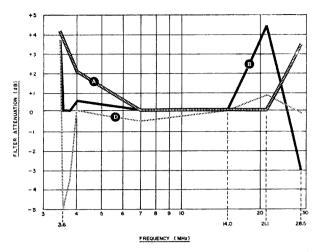


Fig. 2. Attenuation or gain measured with several high-pass filters in the receiving antenna line.

below 10.7 MHz that might beat into the 14 MHz band, another filter was built using a coil of 0.37 μ H consisting of four turns airwound on a ¾-inch diameter, with two .0003 μ F capacitors. No signal-generator measurements were made, but the S-meter indicated that there was a very slight loss at 14 MHz, and a large attentuation on the lower amateur bands.

Conclusion

No attempt was made to correct a possibly very poor standing-wave ratio for the undesired frequencies. This might be done with a resistor across each end of the high-pass filter. The impedance then presented to the filter may not deviate very widely from the design impedance. It would reduce desired signals somewhat. Without resistors, some reduction in the adverse effects upon the rejection of undesired signals by the poor match for off-frequency signals, may result from using two or more filter sections.

Lacking an all-band receiver, no attenuation measurements were made in the rejected frequency range. The filters have been used for a number of months. In a few cases, a single-section filter has brought in a weak spurious signal that was not present in the straight-through switch position. About half of the apparent commercial intruders in the 14 MHz band were weakened or eliminated by a filter, where this phenomenon was due to two signals intermodulating within the receiver. It has been interesting to find that high-pass filters were more effective than an added tuned circuit, with less loss.

Letters

Up to Data Articles

Dear 73:

Just a short comment on your excellent articles—last year I taught electronics in a high school vocational program and used many of the design and more technical subjects as teaching aids. Your topics are so up to date that I have incorporated some of the circuits I've found in 73 in the R&D laboratory at which I'm presently employed.

Edward F. Steinfeld, Jr. 7587 Roselawn Drive Mentor, Ohio 44060

73 is Stronger

Dear 78:

It seems that 73 is made from better stuff than Brand X or Brand Y. It is noticeably more difficult to drill holes in 73 than in the other mags. 73 almost stalla a 1/4 inch drill with a 1/5 inch bit . . .

Adam Denison, Jr. W4RWH Bowman Gray School of Medicine Winston-Salem, North Carolina

1967 International Mobile Rally

Dear 73:

Please announce to your readers that they are all invited to the 1967 International Mobile Rally to be held at RAF Alconbury, Huntingdonshire, England, on 18 June 1967. This rally is jointly sponsored by the United States Air Force and the Amateur Radio Mobile Society. Every effort is being made to provide truly international representation at this rally; correspondence concerning this show should be sent to the Project Officer, Mars Director AJ1AA, International Rally, Rox 3234, APO New York 09238.

George T. Martin, Jr. Capt., USAF G5ACY

Experiments with Gravity

Dear 78:

I have heard of a national group of some kind involved with amateur experimentation using gravity for communication and/or motivation. I would be very interested in how to contact someone to obtain further information.

Harold Johnson WA6DZL Box 144 La Puente, California 91747

Can anyone help Harold?

Disappointed

Dear 73:

And now you have come out with a new binding which seems to be very similar to the unmentionables. Contrary to statements it does not stay open on the bench. I cannot even keep it open while I read it. Your articles have always been good, but not really that much better than QST or CQ. If this keeps up I will enter by subscription to S-9 (for CB'ers); at least their magazine stays open.

Jay Johannes WA90HS 4235 North 68th Street Milwaukee Wisconsin

Helping Out

Dear 78:

The International Telecommunications Union, the organization established 100 years ago to regulate international communications, will be meeting in the next couple of years. To keep amateur radio and allow it to grow, we need the neutral countries; The Afro-Asian countries who have no need of our bands for propaganda purposes.

A few years back the balance of power was held by the European countries and the U.S., but now because of the one vote per country rule, it is in the hands of the new countries of Africa. This is because she has most of the new countries; we need Africa.

I have talked to many African Students, and the majority of them don't even know what amateur radio is. These are the future leaders, the sons and daughters of the ruling families. If these leading families don't know about amateur radio, we must teach them.

Why don't we start a campaign to educate these students to the good of amateur radio? We all have extra gear in our junk boxes that could be donated to this cause. Interested parties please contact me.

Bill White W3TYV 308 Gaskill Street Philadelphia, Pennsylvania 19147

All Homebrew

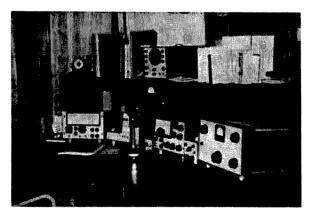
Dear 73:

Here is a photo of my homebrew amateur radio station W9DSP. This equipment is mostly solid state and has been under construction for about three years. That is to say it has been in use for the past two years with about one year of building.

It is obvious to me as a subscriber to 73 that your policy is futuristic and encompasses the solid state concept of the art. It might be enlightening to your readers to publish a picture of this solid state equipment at the amateur level; in the past two years of operating this equipment, almost invariably the station I am working exclaims to me that I am his first QSO with someone who builds, let alone all transistor circuitry. Hi.

Keep up the good work on advanced techniques in amateur radio; we need this information to survive.

> Willy Moulton W9DSP Route 4, Box 136 Chippewa Falls, Wisconsin



Left to right at W9DSP: All transistor receiver covering 3.5 to 30 HMz with room for 6 and 2 in the future; Includes FET's. Power supply and control. 125 watt DC input transmitter; all transistor except for three tubes. Includes YOX, VFO, PTI, five bands. Solid-state electronic keyer. tube-type linear with pair of 572B's and self-contained power supply. And on the shelf, an all-solid state (except CRT) scope and RTTY terminal unit.

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Jerry Hardison II, first licensed as WN4AEF at the age of nine, now has his general license, WB4EQX. Jerry, now eleven, finds time between his school studies to work 80 CW and 10 and 2 meter phone. He is an avid homebrew builder and he says his first love are the transistor projects from 73. He won first prize at a recent high school science fair with a transistor tester similar to the one in the September 1966 issue of 73. Jerry's OM is W4HQM.

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MIDWAY ANTENNA ● Dept. A7-1 ● Kearney, Nebraska

Technical Aid Group

The first members of 73's Technical Aid Group are listed below. They are willing to help other hams with their technical problems. If you have a concise question that you think can be answered through the mail, why not write to one of the hams on the list? Please type or write legibly, and include a self-addressed stamped envelope. One question to a letter, please.

If you'd like to join the Technical Aid Group and you feel that you are qualified to help other hams, please write us and we'll furnish complete information. It's obvious that we need many helpers in all parts of the country and in all specialties to do the most good. While 73 will try to help with publicity and in other ways, we want the TAG to be a ham-to-ham group helping anyone who needs help, whether they be 73 readers or not.

Don Nelson WB2EGZ, EE, 9 Greenridge Road, Ashland, N.J. 08034. VHF antennas and converters, semiconductors, selection and application of tubes.

Tom O'Hara W6ORG, 10253 East Nadine, Temple City, Cal. 91780. ATV, VHF converters, semiconductors, general questions.

Stix Borok WB2PFY, high school student, 209-25 18 Ave., Bayside, N.Y. 11360. Novice help.

George Daughters WB6AIG, BS and MS, 7613 Notre Dame Drive, Mountain View, Calif. Semiconductors, VHF converters, test equipment, general.

Roger Taylor K9ALD, BSEE 2811 W.

William, Champaign, 1ll. 61820. Antennas, semiconductors, general.

Jim Ashe W2DXH, R.D. 1, Freeville, N.Y. Test equipment, general.

J. Bradley K6HPR/4, BSEE, 3011 Fairmont St., Falls Church, Va. 22042. General.

Howard Krawetz WA6WUI, BS, 654 Barnsley Way, Sunnyvale, Cal. 94087. HF antennas, AM, general.

Robert Scott, 3147 E. Road, Grand Jct., Colorado 81501. Basic electronics, measurements.

J. J. Marold WB2TZK, OI Div USS Mansfield DD728, FPO San Francisco, Calif. 96601. General.

Hugh Wells W6WTU, BA, 1411 18th St., Manhattan Beach, Calif. 90266. AM, receivers, mobile, test equipment, surplus, repeaters.

Richard Tashner, WB2TCC, 163-34 21 Road, Whitestone, N. Y. 11357. High school student, general.

Wayne Malone W8JRC/4, BSEE, 3120 Alice St., West Melbourne, Fla. 32901. General.

Louis Frenzel W5TOM, BAS, 4822 Woodmount, Houston, Texas 77045. Electronic keyers, digital electronics, IC's, commercial equipment and modifications, novice problems, filters and selectivity, audio.

Michael Wintzer DJ4GA/W8, MSEE, 718 Plum Street, Miamisburg, Ohio 45342. HF antennas, AM, SSB, novice gear, semiconductors.

Clyde Washburn K2SZC, 1170 Genesee Street, Bldg. 3, Rochester, N. Y. 14611. TV, AM, SSB, receivers, VHF converters, semiconductors, test, general data.

DXERS and DXERS-TO-BE

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The VHF'er

Parks Laboratories
419 SW First, Beaverton, Oregon

What's New for You?

Response to this column has been fairly light so far. I think that part of the reason for this is that the name we've been using doesn't fit what we'd like the column to be. We're open to suggestions for a new name. The column is meant as a forum for short, timely notes that are of interest to technically-minded hams. We're looking for contributions from you, our readers, about new transistors and other components that you've used and found interesting. We also want notes about new surplus, technical conventions and meetings, technical nets and clubs, moonbounce skeds, and comments and corrections to 73 articles. All items will credit the contributor. Please send in your notes as soon as possible so that all 73 readers can take advantage of them. Send to Paul Franson WA1CCH, 38 Heritage Rd., Acton, Mass. 01720.

More Gain for the SB-100

Here's a simple hint from John Butrovich W6GTJ, for increasing the gain of the Heath SB-100, particularly on the 10 and 15-meter bands. It also makes the S-meter a bit s livelier. Simply reduce R-221 from 470 Ω to about 47 Ω . This increases the gain of the receiver considerably by increasing the injection voltage from the LMO to the second mixer. It also seems to improve the signal-to-noise ratio and has apparently caused no problems.

February Propagation Forecast

The symbols and forecast for the February propagation were a bit mixed up. Apparently the January forecast was inadvertantly repeated in February.

ATV Directory

Donald Levine WB2UMF, 150 DeLong Ave., Dumont, N. J. 07628, is trying to compile a list of ATV'ers all over the world. If you're interested in ham television, please send the following information to him so

that he can list you in the directory: name, call, address, phone number, equipment for ATV, and whether or not you're on the air now.

Corrections

There were several errors in the schematic for the "Silect Six Meter Converter" in the January issue:

1. There should be a connection between the oscillator tank circuit and 0.001 bypass capacitor to the supply voltage shown on the schematic; the etched circuit board showed this correctly.

2. The etched board layout shows a connection directly from the 12 volt supply to the rf stage tank coil; it should be connected through a 56k resistor as shown in the schematic.

3. The new designation for the Cambion SPC-1 coil forms is 2170-2-3 (1 to 20MHz); 2170-3-3 (20 to 50 MHz); and 2170-4-3 (50 to 200 MHz),

· . . Bob Boyd W1VXV

Phase-locked oscillator

A couple of errors crept into the "Phase-locked UHF Microwave Oscillator" on page 68 of the February issue. The polarities of CR5 and CR7 are both reversed on the schematic. Two R22's are shown on the schematic; the one referred to in the text is 500 ohms. Also, the fifth sentence in the second paragraph on page 74 should read as follows, "If the C_a and C_b used had ranges up to 7-10 pF, the frequency of your initial output should be about 600-750 MHz. When you have determined, with the power meter or receiver . . ."

UHF Multiplier

The circuit diagram in Fig. 1 on page 22 of the February issue ("An Improved Multiplier for UHF") gives the wrong pin numbers for the 6J6 oscillator-multiplier. The plates and grids are interchanged.

G. W. Cunningham WB2SRD

Kyle's Current Controller

John Derby, 1124 Hedgewood Drive, Lafayette, Ind., points out that K5JKX's simple current controller on page 96 of the December 1966 issue is a little too simple. Unless the screen regulator gets its voltage from some other source, it isn't going to work at all as he describes it. While the plate current of the 6V6 remains essentially constant,

DONATE YOUR EYES SO THAT ANOTHER MAY SEE

Great advances have been made over the past 25 years in the repair of damaged corneas, the clear substance that covers the pupils of your eyes. The only material that can be used to make these repairs comes from other eyes-those WILLED by their owners for removal within 4 hours after death, and the degree of success in these operations is astonishingly high.

Hundreds of people every year are able to see again because of these donations, but even so the availability of eye material is so limited that the majority of the over 75,000 who should have this surgery will not live long enough.

The need now is for hundreds of thousands of additional pledges to produce an ever increasing availability. A thousand pledges today may produce no material for many years. so the greater the pledge group, especially among the upper age levels, the greater the chance that many of those who need this transplantation will indeed live to see again.

Obtaining these pledges has been a project of Lions Clubs in many cities, and their members, or Doctors and Hospital Administrators. direct you to a source of pledge cards which you and your family must complete to make an eye donation valid. Here is a project for entire families. What greater gift could you give to a fellow man!

PLEASE INCLUDE YOUR ZIP CODE WHEN YOU WRITE 73.



QUAD AND BEAM BREAKTHRU

QUAD AND BEAM BREAKTHRU

QUADS: PROVEN SENSATIONAL! All metal (except spacing insulator dowels); full size; two element; absolutely complete with steel boom; all hardware; wire and fittings; terrific gain and directivity; one man installation; no bamboo or fibreglass; all quads use single 52 ohm coaxial feedline: 10-15-20 Quad, \$35; 15-20 Quad, \$32; 10-15 Quad, \$30; 20 Meter Quad, \$25; 15 Meter Quad, \$24; 10 Meter Quad, \$23.

BEAMS: new complete with boom and hardware; SWR 1:1; handles 5 KW; adjustable entire band; \(\frac{7}{6}\) and \(\frac{1''}{2}\) all \(\frac{1}{2}\) \(\frac{1}\) \(\frac{1}{2}\) \(\frac{1}{2}\) \(\frac{1}{2}\) \(\frac{1}{2}\

TWO-WAY COMMUNICATION CRYSTALS

AMERICAN CRYSTAL CO. PO BOX 2366 KANSAS CITY, MO. the current through the string of NE-2's will vary inversely with R1. If they are drawing about 5 mA at 300 V, they'll draw about 100 mA at an input voltage of 750. Also, Kyle starts out with plate and screen both at 250 V, Screen reg, none!

Amperex Linear IC's

In mentioning these, we're departing from the usual policy of reporting on semiconductors recommended by readers who've used them, but they look especially interesting. Amperex calls one (TAA320) a BIFET -it's a MOSFET and conventional silicon transistor on a single chip, mounted in a 3-lead, TO-18 case. This results in a simple, low-noise, high-gain unit with very high input impedance (10 G Ω). Cost is low, too, around a couple of dollars. Another Amperex IC is the TAA310 class A preamplifier with 100 dB gain for audio use. It's cheap, too. Burstein-Applebee and Newark carry Amperex semiconductors.

. . . Paul Franson WA1CCH

Weatherproofing

Making a dependable weatherproof connection or seal can be a real challenge under certain conditions; it is even more difficult if it is needed 50 feet up a tower between the temperature extremes of 90°F above to -40° F, often conditions in Western Canada. An antenna experimenter, or anyone else for that matter, should look at the most economical weatherproof sealant I've found until now: Roof Shingle Cement, a sticky asphalt compound, available either in cans or in caulking gun cartridges. Any connection, splice or part to be sealed should be tightly wrapped with plastic tape and then covered with one or more layers of this compound. If the treated unit never (?) has to be opened, no plastic tape is needed, just make sure all cavities and holes are sealed to prevent condensation; be sure, because this stuff really sticks. After a while the outside forms a dry skin but the inside remains soft and prevents cracking of the seal. This asphalt compound does not seem to degrade coax lines or other materials; I did not notice any changes in the rf characteristics when used on baluns and loading coils. It is more easily available than any other weatherproof preparation suitable for amateur antenna use.

. . . Bob Fransen VE6TW

Climbing the Novice Ladder

Part VI: The formal code exam.

The eventful Saturday marking the formal code test for Judy and Joe dawned raw and chilly. A light mist ushering in the fall season lent further depression to the gray and gloomy atmosphere. Far from being daunted by such vagaries of nature, Judy's ill-concealed excitement allowed her to make but slight inroads into the tempting plateful of scrambled eggs her mother had prepared for breakfast. Far across town, Joe pushed his half-eaten waffle and sausage to one side with the lame excuse, "Guess I'm not very hungry this morning" which resulted in an exchange of knowing smiles between his parents.

Larry had arranged to pick up Joe, stopping by on the way to FN's place, to pick up Judy. Both kids had received their FCC application blanks during the week but without a reminder from Larry, Joe would have left his at home; the more methodical Judy had hers carefully tucked away in her purse when Larry arrived. Pulling into FN's driveway they made a quick dash for the house ducking what had now settled into what looked like a determined all-day rain, as best they could. FN met them at the door and after the usual hearty greetings said, "Well, you kids could have picked a brighter day for an exam but we'll be warm and cozy inside; Ma's got a cherry fire blazing in the living room fireplace; let's go up there and be comfortable." Hot coffee ready and waiting, did a great deal to relieve initial tensions and with the last swallow of the warming fluid FN asked, "You bring your FCC application forms? Larry told me the other day that you'd received them". "Right here Gramps" replied Judy removing hers from her purse while Joe silently retrieved his from an inner pocket. "Fine; suppose you both sit here at the table then and fill in your part . . . here's a couple of pens. I see you brought the little ABC's book Judy . . .

use the sample form in Appendix H as a guide. Larry and I will have another cup of coffee and if you hit a puzzler you can ask us about it."

The forms were simple and in a matter of just a few minutes they were ready. "Yours to Larry, Judy . . . I'll take Joe's". Both appeared to be in proper order so FN announced, "Suppose we go down below now and set up the CPO, round up some copy paper and pencils and have at it." No sooner said than done and in a few minutes FN said, "Guess we're all set now; as we have but the one CPO you'll have to work together rather than separately. I've chosen some copy from one of the military manuals; it has mixed letters and figures and some punctuation. Larry has looked it over and agrees that you shouldn't find it too difficult



... a rainy day for the exam ...



. . . the warm-up run . . .

to copy. He seems to think that I have the steadier fist, which is probably just some of his Blarney but he's asked me to do the sending. He will copy right along with you probably hoping that he can trip me on a mis-cue here and there, eh Larry?" "Don't be so modest, FN" replied Larry, "when have you ever sent a wrong character?" With a chuckle FN said, "Plenty times . . . plenty, but all right, if thats' the way you want it, remember you asked for it!" I'm going to send just a bunch of random stuff for a few minutes to give you kids a chance to get the shakes out of your writin' hands . . . kind of a 'warm up' run. Copy what you can but remember, if you're doubtful about a character don't hesitate to puzzle over it . . . Just skip it and go right on." With that FN commenced with the attention sign and continued in a slow, steady rythm, sending sentences from the book in front of him. Joe and Judy industriously copied with complete concentration for what seemed an interminably long time. At last FN wound up with a flourishing 'SK' and the two kids laid down their pencils with long, relieved sighs. "Well, how'd you do?" came from FN. "I dunno Gramps," said Judy; "for the first minute or so it seemed like a bunch of jibberish to me but then I began to catch on and it came a lot easier; maybe I didn't do too bad". "let's see" said FN, reaching for her paper and passing it to Larry with, "You look it over Larry, I'll see what Joe did with it". Taking Joe's copy, FN checked it character for character with the copy from which he'd been sending, then passed the book to Larry who in turn re-checked Judy's effort. "Looks pretty good here FN" and unseen by either youngster, Larry slipped a sly wink toward FN who acknowledged with a slight nod. "Now" said FN, "before you kids do any more copying, suppose you take a little break from the pencil and limber up your wrists on the key; you'll have to send as well as receive you know and you don't want to be stiff. Iudy, suppose you send this short paragraph for a warm-up session; we'll all copy . . . you too, Joe . . . and see what you can do." Judy took the book and starting where FN had indicated steadily plugged along to the end of the paragraph. "Now Joe", FN said, "take the next paragraph and Judy you copy him this time along with Larry and me." When Joe had completed his run, FN carefully checked against the book and then mystified both of the kids by exchanging broad grins with Larry. This was immediately explained though when FN said, "Congratulations; you have both passed your sending and receiving tests with a good safety margin . . . nice goin." "How come," Joe said . . . "was that the exam?". Laughingly FN replied, "It sure was Joe; a little psychological trick I picked up long ago when I first commenced to examine novices. Almost invariably they'll be much less tense and at greater ease if they don't know they are being formally examined and think it's just a 'practice run'; had you fooled didn't we? Larry and I had this all fixed up beforehand and you walked right into our little trap and obviously to your advantage. Here's the results; we had already counted characters in the material you sent and received so it was possible to quickly gauge what you did when you finished. Joe, in your receiving test, you came up with five errors in the five minute run; in four cases it was that same old letter Y that has been plaguing you. The other error was that of omission; you apparently missed a character, let it go and went on with your copy, as you should. However, three times in the five minutes you copied 25 or more characters solid; any one of these solid copy stretches would have passed you. You got a little added break in one run; it contained three figures and a punctuation mark; remember, these all count as two characters in the final score but even without that bonus, you made it; very good lad. Now Larry, what did you find in Judy's

98 73 MAGAZINE

copy?". "Error-wise, she did better than Joe, FN; Judy you chalked up only three errors but they occurred at points which left you, like Ioe, with three complete 25 character strings, more than ample to pass you. Two of your errors were in figures so that cost you four characters really, plus the other one which was copying an 'x' for a 'y' and counted as a single error, so you and Joe were actually just about even. FN, what did you figure your sending speed to be?" "I tried to hold it as close to 5wpm as I could judge Larry," replied FN, "but maybe force of habit sneaked it up a bit on me for I was actually sending at an average speed of slightly over 6wpm . . . say about 64, so if either of the kids had failed, I'd have had to run it over and bring my speed down to exactly five". Beaming faces and broad smiles from both kids greeted these remarks and then Judy chimed in with an eager question. "How about our sending then; tell us about that". Nodding to Larry, FN said, "Go ahead Larry and give Judy an analysis of what you think of her fist".

"Well Judy, I'm going to give you a baby Oscar on that one; you've developed a nice, clean steady fist and your character formation is excellent as I think FN will agree. I clocked you at just slightly over 6wpm . . . perhaps FN's sending cued you in at that speed. More than you needed but even better so. You made only two errors in the entire five minute run; one was in adding an extra dot to the figure 7, the other was in making a period where it should have been a comma. Now let's see what FN's got on Joe. "This time I'm going to give Judy the edge on Joe," FN said, "remember, I copied both of them. Judy's sending was steadier than Joe's. It was evident that he was crowding himself a bit for speed. You came out at exactly 7½wpm Joe, probably through a sub-conscious feeling that maybe you weren't quite making your required five. As a result, your sending was a bit jerky; you'd have made better characters and fewer errors had you held down to 5 or 6wpm, however you made readable copy in two runs of better than 25 characters each which, of course, passes you. You made seven errors scattered throughout; here's your paper-I've marked the mistakes and you can check them against the book." While Joe was checking his copy, Larry gathered up the miscellaneous papers while Judy's relief was evident in her completely relaxed slouch in her chair. "I'm wondering

about something," said FN, "in this past week you kids have both taken a rather sudden spurt in cour copying speed-you been practicing together a lot this week?" "None" Judy replied, "Joe phoned me and said that Larry had shown him where to find the code practice transmissions on the amateur bands and he told me where to look for them. So, we both tuned 'em in on every schedule we could possibly make. That sure helped-thev came through on both of our receivers just like we were in the room with a CPO. A little ORM at times but plenty of good solid practice. Boy, I'm really sold on copying actual signals-makes you concentrate a lot harder, doesn't it Joe?" "Right" returned Joe, "I sure got in a lot of good licks with my old BC-312". "Swell," came from FN, "stay right with it-you're going to be shooting now for the 13 wpm you'll need for your General class exam within the year and you'll get a lot of help from the CP stations. Don't relp too much on copying other hams at random, particularly the novice group. You'll find all kinds of fists, good and bad but the CP stations practically all use automatic tape transmissions which is perfect character formation and that's the type of transmission you'll have to copy at the FCC office when you take your General exam. Well, we've got about an hour before lunch time; do you want to talk about transmitters for a bit? If you pass your written tests you know, you're free to get on the air the minute you receive your license and call letters from FCC; be a good idea to start thinking about what you're goin' to use for transmitters". Eagerly Ioe said. "Gee FN, I'd sure like to start doing something about a rig; I'd like to get on the air just as soon as I get my license". "Me too," Judy chimed in. "I'm getting kinda anxious to talk back to some of these stations I'm hearing all the time. My little CONAR receiver is sure hauling 'em in and I'm getting so I can read quite a bit of what they're saying".

"All right" said FN, "let's see what we can do about it. There are several ways in which you can acquire a proper transmitter for your novice operation and, if you plan right, it can be a piece of equipment which you can carry right over into your General class activity when you reach that stage. First off, is the 'home-brew' approach. While I'm a great believer in the ham building as much of his equipment as possible, I'm going to discourage this angle for you kids. Here's

why; you can build a very satisfactory little rig from scratch by following one of the many designs for simple rigs in any of the handbooks or from one of the magazine articles. Sometimes, this is the least costly approach moneywise although the time element for such construction will penalize you a bit. Ordinarily, like you kids, the novice will have little in the way of a 'junk-box' which hams call the miscellaneous accumulation of parts and components which they inevitably gather as their ham career progresses. The amateur with a couple of years or so of ham background can generally pull about 50% or more of what he'll need to build a piece of gear, right out of his junk box collection. However, if practically everything you'll need to put together a novice transmitter must be purchased new, money saving is a bit questionable. On top of that, the relative inexperience of the novice hardly lends itself to producing a really presentable job particularly if he is unequipped with such convenient tools as socket punches, hand or electric drill, nut-drivers, soldering iron and similar items. To have to buy these in addition to parts runs the cost figure to a pretty substantial sum. In my opinion, the novice is really better off to take another approach and defer the major home-brew construction until he is a little better equipped all ways. And what other approach do I recommend? There are several; let's examine them.

"You can buy a brand new, factory assembled and wired transmitter, ready to go. There again, you're going to face a rather substantial cost item. And, by so doing, you won't learn anything about electronic construction; just adjustment and operation. The older hams term this approach being an appliance operator'-just a button pusher and knob-twirler' as it were. Later on in your ham career, after building a number of pieces of equipment, you can think seriously about buying some good factory-built job. You'll find then that through the experience gained in building a few items from scratch, you can handle a commercially built job much more effectively through a better understanding of the functioning of the various components.

"Another approach is to buy a good, used transmitter if of a reliable make, free of modifications and including the factory instruction book; this latter is important both for operation and maintenance. Here again



The novice transmitter . . . to buy or build, kit or surplus, homebrew or factory assembled?

however, you gain little in furthering your knowledge of electronic construction but you will effect quite a substantial saving over the cost of a new piece of gear. Then too, there are always the kits and they are far from a poor bet for the novice. In addition to being priced considerably below a factory completed job, they do give you a certain amount of assembly and wiring experience which you won't get on a complete factory built job. Too, the really hard work is done for you such as holes punched and drilled in chassis and panel, panel lettering applied and many little niceties accomplished for which you would require a rather impressive list of special tools; pliers, screw driver and a soldering iron just about cover the major tool requirements for putting together a kit.

"Personally, I favor for the novice, either buying a new kit of reliable manufacture or, as second choice, a good used transmitter of well-known national make. Both of you kids have catalogs of the leading kit makers, Knight-Kit, Heathkit, Johnson and others. I'm going to suggest that you go through these carefully and see what you can find that is suitable for novice operation and priced within your budget. While you're

thinking these over, make another round of our three local electronics stores and see what they may have on their used equipment shelves. In general, it is better that you avoid a piece of surplus military gear; there are lots of good items among them but ordinarily they are not completely adapted to novice operation without considerable modification which, while relatively simple for the experienced ham is usually a little bit rougher than beginner should tackle.

"Suppose then, you do as I suggest; study your catalogs and visit the stores. When you think you've come up with something that looks like it might fit your picture, come on out and we'll talk about it. Meanwhile, don't forget that while you've satisfactorily passed your code tests, you still have the written examination ahead so keep right on boning in the little books . . . you'd hate to think you'd made the code and then flopped the written

portion, wouldn't you?

Assuring FN that they most certainly would keep on with their study, they agreed to his suggestions and as lunch time was fast approaching, all three loaded into Larry's 'Gallopin' Gertie' for the homeward trek shouting their "73" to FN as they drove off. . . . W70E

Hand Buffer

Some of the homebrew specials look a bit rough at times due to the use of heavily tarnished surplus connectors. The average amateur has no means for cleaning them easily and soaking in any kind of solvent does more harm than good. Many connectors, materials and other parts are often very fragile and impossible to clean with sandpaper or solvent. One of the best and easiest ways of cleaning these things after trying everything else is by using a so-called "suede leather brush" as a hand buffer. This is a small brush made with copper clad steel wire and intended for cleaning and sprucing up suede leather shoes. These brushes can be real life savers to a home builder and work wonders on tarnished silverplated rf connectors and similar parts. They are also a great help in cleaning a plated chassis without scratching it, cleaning files, etc. At 25-30 cents these brushes are a real buy.

. . . Bob Fransen VE6TW

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Heathkit HW-32A 20 Meter SSB Transceiver

When Heathkit brought out their single-band transceivers a little over three years ago, they immediately became very popular. They were low in cost, versatile, compact and ideal for the ham who wanted to move up to SSB with a minimum of effort. Now the people out in Benton Harbor have gone one better—they have introduced a new set of single-banders with even more features than the original.

These new single-banders feature upper and lower sideband selection on all models, improved audio and AVC response, automatic level control (ALC) input for external linear amplifiers and improved design and styling. The nicest feature of all is that all these additions are available at no additional cost. In fact, the price is even lower than the original models. With prices increasing everywhere, it's refreshing to see a new piece of amateur equipment offered with a lower price tag.

Heath's famous quality is evident throughout the entire HW-12A, 22A and 32A line. This borne out in on-the-air performance; both the receiver and transmitter have been designed for optimum SSB performance and show it. The 1 μ V sensitivity, 2.7 kHz selectivity and slow AVC action make for very enjoyable SSB operation. The 200 watt PEP of the single-banders isn't going to crack any DX pileups, but all continents can be worked without a great deal of effort. In only a couple of days of part-time operation WAC was made from W1DTY with excellent reports.

For the ham who wants to work mobile, the HW- series is really the ticket. Mobile performance with the HP-13 DC power supply is excellent. A mobile mount is supplied with every unit and the front-panel bias control speeds up conversion from fixed station to mobile use.

In the receiver, the pentode section of a

6EA8 is used as an rf amplifier. The triode section mixes the input signal with the VFO to provide an output at the 2304 kHz if. This combination results in a sensitivity of 1 μV for a 15 dB signal-plus-noise to noise ratio.

The four-crystal crystal filter following the mixer exhibits 2.7 kHz selectivity at the 6 dB points and 6 kHz selectivity at 50 dB down. Two 6AU6 if amplifiers, a 12AT7 product dectector and a 6EB8 audio amplifier and power stage complete the tube lineup in the receiver.

A 6EA8 microphone amplifier and cathode follower in the transmitter drive a diode type balanced modulator. The output of the balanced modulator is amplified by a 6EA8 transmitting if amplifier before the signal is fed into the crystal filter. From the crystal filter the signal is amplified by another if amplifier, a 6AU6, and then mixed with the VFO signal in a 6EA8 mixer stage. In the final a 12BY7 driver stage pushes a pair of 6GE5's to 200 watts PEP input.

The Heath single-band transceivers may be switched from transmit to receive by either push-to-talk or the built-in VOX circuitry. The 6AU6 VOX amplifier is normally operated in a saturated condition, but when audio is applied to the grid, the plate voltage rises and fires a neon bulb, providing positive switching action. The voltage from the NE-2 neon is amplified by the relay amplifier, the triode section of a 6EA8, which operates the transmit/receive relay. The builtin antitrip circuitry and VOX delay result in very smooth VOX operation. The VOX delay and VOX sensitivity controls are located on the rear panel where they are easily accessible during initial VOX adjustments; after that they may be virtually forgotten.

A 6AU6 is used in a Colpitts type VFO circuit and the stability characteristics are excellent. The circuit is completely temperature compensated and after a warmup of 30 minutes, the drift is less than 200 Hz per hour. To a large degree, the stability and drift characteristics of this VFO are directly attributable to its relatively low frequency of operation—1618.3 to 1771.7 kHz. The VFO output is mixed with the output from a crystal controlled heterodyne oscillator to obtain the required mixing signal for 20 meter operation.

The back-lighted dial is very smooth much smoother than some transceivers I have used costing several times as much The

two kHz dial calibration is very convenient and when used with the optional crystal calibrator, you know exactly where you're operating without a lot of interpolation. In these new single-banders the crystal calibrator socket is built in and the calibrator is controlled from the front panel-all you have to do is build the calibrator.

Construction of the HW-series single-banders is simplified by the use of a printed circuit board and a factory-prepared wiring harness. In fact, over 90% of the components are mounted on the printed circuit board. With this type of construction, assembly time is drastically reduced and wiring errors are almost non-existent. With the extensive directions and pictorial layouts provided in assembly manual, wiring smoothly and rapidly. Even the alignment is no problem-all you need is a broadcast receiver, a VTVM with an rf probe and a

Heathkit HW-32A Specifications

Frequency	coverage:	14.2	to	14.
CI *4* **				

Sensitivity:

1 μV for 15 dB signal-plusnoise to noise.

Selectivity:

2.7 kHz at 6 dB; 6 kHz at

50 dB.

Spurious responses:

Image rejection, 60 dB; if

rejection, 65 dB. 45 dB below peak output

Carrier suppression:

(minimum).

Sideband suppression:

45 dB below peak output with 1000 Hz modulation

(minimum) 200 watts PEP.

RF power input: Antenna impedance:

50 ohms nominal.

Frequency stability:

Less than 200 Hz per hour

after warmup.

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sideband, external automatic level control (ALC) sideband, VOX, improved audio and

Tube lineup:

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Features:

AVC circuitry. 6EA8 microphone amplifier and cathode follower, transmitter if amplifier and relay amplifier, and rf amplifier and receiver mixer;

6AU6 Vro, fier, if amplifiers, and mixer: 6BE6 6AU6 VFO, VOX ampli-VFO cathode follower, 12AT7 product detector and carrier oscillator, 6EB8 audio amplifier and audio output, 12BY7 driver and

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HP-13 DC power supply, HP-23 AC power supply, HS-24 mobile speaker and

HRA-10-1 100 kHz crystal

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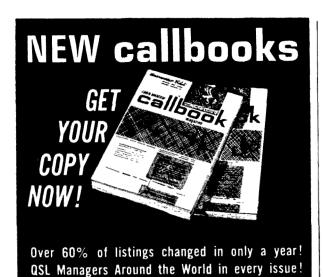
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dummy load. All the tuned circuits are prealigned at Benton Harbor, so it only takes a few minutes to get everything tweeked up.

Operating voltage for these transceivers are furnished by an external supply—either the HP-23 for fixed station use from 117 volt lines or the HP-13 for mobile use. The supplies are wired internally so they may be turned on and off with the function switch located on the front panel of the transceiver. The filament wiring is a series-parallel arrangement which balances the filament voltage without power-robbing dropping resistors.

I have used the HW-32A on 20 meters for several months now, and the audio and carrier suppression reports are always excellent. During a recent DX test the HW-32A with a linear amplifier added a couple of new countries to my WTW list. Whether you are an AM'er still procrastinating against SSB or are simply looking for a new mobile rig, the Heathkit HW- single-band transceivers are the most economical units available. They are dependable, compact and versatile—a tremendous value on today's market

. . . WIDTY

Mobile Mike Holder

Many times the new owner of a mobile mike finds himself without a mike holder. If you are in this predicament, and your mike is the type with the button mounting as used by Shure and others, here is a possible solution.

The only material required will be a short length of rectangular extruded aluminum (or waveguide). This is available in many different sizes and most metal supply houses and surplus metal stores will be able to furnish the extrusion. The dimensions are not at all critical. A recommended stock size would be ½ x 1 with a .125 wall thickness. The maximum length required is 4".

On one side of the extrusion drill and file a ½" wide slot that will accommodate the button hangar on the rear of the mike. The slot should be about 2-3" long. On the opposite side drill clearance holes for two sheet metal screws that will be used to secure the holder to the automobile.

The appearance may be enhanced by anodizing or painting.

. . . Larry Kinner K6VNT

Proper Terminology

If you want to become known as an expert in any field, and this is particularly true of ham radio, there is no substitute for knowing and using the proper technical language. Obviously, it's more difficult to impress friends and acquaintances if they have no trouble understanding what you're talking about.

To help you overcome this problem, the following easily understood words and phrases are translated into terms calculated to make you stand out as an authority. Thus,

Don't say

The proper term is

It has a handle

The darned thing won't work I made a lucky guess

I poured the coal to it

I don't know why the circuit works My gear is the most This gear is the ultiexpensive on the market

I cut and tried until The problem was it worked

It won't work

The whole dammed thing blew up

Lucked out

The unit is portable even if it weighs 500 lb

It needs refinement

It was a matter of interpolation

I worked to maximum operating parameters

It's a sophisticated circuit

mate in precision equipment

solved by empirical means

There are technical problems

This ranges from temporary setback to catastrophic failure

Persistent effort resulted in phenomenal success

Now that you see how the process works, you can easily add many more terms to your vocabulary. A word of warning, though, be sure you're not talking to someone else almost as smart as you are. You won't know who's doing the snow job-I mean giving the technical explanation.

. . . Alton Glazier K6ZFV

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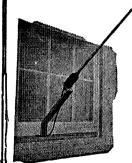
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Gus!

Part 23

This trip from Burundi to Kigoma was a real hair raising experience let me tell you. Over swinging bridges, over very deep gorges, very bad roads, and no road signs at all. A great many animals were seen that night, leopards, lions, even three gorillas, many, many hyenas and countless other animals, many of them I don't even know the name of. Some even John said he had never seen before and mind you he had been down there for a number of years. The road was just about as bad as the Bhutan/ Thimphu road which many of you have seen my color slides of. We took off with plenty of spare gasoline, oil, water, a few sandwiches, and two thermos bottles of coffee, all of which was consumed on the trip to Kigoma. This was by far the worst part of Africa I have ever seen, before or after, its real "wild country", very primative natives, some half dressed some not dressed at all. The men-folk were all painted with no smiles from any of them either. It was one of those trips that really gives a car a good going over. Luckily we had no car trouble. I forget the exact mileage between the two places. As near as I remember it was something like 125 miles, and it took us until the next afternoon to get there, some 15 hours to drive 125 miles-that's mighty slow progress but it was the best we could do on that primative road. Things down there are run very odd. The first thing you do when you get to any village, town or city you check with the police, even if you are only going to be there a few minutes or hours. The fact that I was going to leave almost immediately had nothing to do with this formality. To the police we went. After a long wait we finally were ushered into the chief's office. He was of course a native, wanting to know why we were there, where were we going, etc. After

talking to him and filling out half a dozen forms we were permitted to depart. He told us we were permitted to stay there only two hours! These people down there like to throw their authority around when they have a chance, and this fellow was no exception. He let you know this from the time we entered his office until we departed (Gladly too!). We headed straight for the railway station, stopping at a market place on the way. I bought a big bunch of very large bananas for 47c to eat on the train (they lasted all the way to Johannesburg, South Africa). Funny thing tho, I still love bananas. After buying the bananas, I tried taking a few pictures of the market place, and boy this caused quite a rucus, let me tell you. One well-dressed fellow (a native), yelled something at me and John in their native tongue and people started coming our way, with very mean looks on their faces, John said get in the car and I did and away we QSYed very QRQ. You don't have to understand peoples' language to know when they are mad-and this fellow was-MAD-. Boy you very soon learn certain things down there, and picture taking without their permission is one thing to not do. They want some shillings for this permission. Anyway we got to the railway station and I mean by the time we stood in line with all those other natives I guess I had absorbed some of the prevailing smells. With my ticket in my hand we headed for my cabin on the train. I mean to tell you I just got settled and away the train departed. I am one of these fellows who hate to be late, but this time we could only blame that chief of police for delaying us so long in his office and his waiting room. These people absolutely will not be rushed. Don't lose your time trying to make them speed up. In fact I dare say that's when they actually slow up. You just grit your teeth

and bear with the situation, and try to figure some other way you will do it the next time. John jumped off the train, saying, "See you from Bouvet Is." or something like that and the train headed away from Kigoma towards Dar-es-Salaam. I started off the trip by eating one of those bananas. and saying to myself, Gus, you asked for it and here it is. You wanted to see Deep Africa. Well you are seeing it and HOW. There was no air conditioning on this train and there were no first class reservations, etc. You just mingled with the natives. If you don't like it just GET OFF, the only other way is to WALK. No busses, airlines, no roads. It's that train or walk. I was headed for a place called Itigi in central Tanganyika where I were going to catch an African bus to take me in the direction of South Africa. The trip to Itigi took all night, and about 4 PM the next day we arrived there. I was smutty, smelly, tired, and probably looked like the other natives by this time, and I just did not give a hurrah either. I wanted to, let's say, "go native", and that's what I had become, or at least that's how I felt about this time. Off the train and to the bus station I headed with all my gear and about three bearers loaded up. I watched them all the way. I could not afford for anything to be missing when I got to Bouvet. Things have a very bad habit of disappearing when you travel like I was doing, and each piece of my luggage was just like a chain. It's no good if one single item is missing. If it is you are stopped cold in your tracks. I did not want this to happen to me, that's why I always stuck very close to my gear. As is usual in these parts, the bus was late. In fact it was what you might say VERY LATE. The bus I was taking was from Nairobi. It arrived about two hours late. I had my bus ticket all ready and when it arrived and I saw all those people waiting for that bus, I made up my mind that I was going to be one of the passengers on it. I had all my bearers standing by with my luggage and had been instructed what to do. When the bus stopped they immediately piled my stuff on top of it, I handed the bus driver a tip and then my ticket, he motioned me into the very front seat. About half of those waiting were left behind and the bus was crammed full with not even room for anyone else to stand. Remember there are no paved roads in these parts of

Africa, at least when I was there they were not paved, and I doubt they are right now. The roads is what you might say "like a washboard" and the bus driver drove at the EXACT SPEED to make each washboard groove felt. I kept thinking of my poor equipment on top of that bus, bouncing around and numerous loose connections developing to cause me headaches later on. The top of this bus was really loaded up. Bicvcles, boxes, radio gear, chickens, and many bags containing Lord knows what. Oh yes I brought my bananas along with me from the train. About this time I ate two of them to sort of get my mind at ease. After a while you get thirsty you know, now where do you get water from? The bus finally stopped to unload a few and take on a few more passengers, every one headed for a well with a rusty bucket and drew up water that was vellow looking, and it even had a sort of evil smell to me. I had saved a paper cup from the Itigi railway station and filled it full of this roughlooking water and drew out one of my "water purifier pills" and dropped it in, after shaking it a while the pill dissolved and down my throat it went. About all I can remember about it was it was wet. warm, nasty but at least it was water. Natives flagged down the bus along the way and by pushing and shoving once in a while one more could get in. If I had been blind I could have told vou I was in Africa. Everyone was washed down with sweat, dirt, and lots of clothing I am sure had never been washed. After a while you get to the point where you just don't smell anything at all. I suppose I sort of smelled like them at this time. I was treated with respect all the way, they gave me a whole seat, even when the bus was loaded down with only standing room. The bus traveled all day and stopped at sundown at one of the "tourist huts" along the way. It cost me one dollar to spend the night at these places. They served you a cup of tea when you arrived and in the morning they would wake you up in time for the bus and gave you another cup of tea. Fairly good beds with mosquito netting on it were to be found at each of these places. The bus would usually come and get me first than go past the little bus station and pick up the other passengers who had been sleeping on the ground around the bus station. At lunch time the bus usually took me past one of

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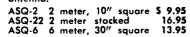
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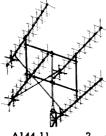


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the tea rooms along the way where a fairly good dinner could be had at a fair price. This was the only good meal I would have each day. During the late afternoon you know a feller gets hungry. I finally got to the point where I would down those dried salted little fish and dried salted other meat along with the natives. It did not give me any trouble that I know of. This is one time that I "went native". I remember we stopped one day at a roadside tearoom in Northern Rhodesia. The temperature was around 110 degrees, and this tea room had a sign outside reading, "Admitted only with tie and coat". In I walked in my shorts, only a white (it was white one time anyway) shirt. They "ordered me out". I tried to explain that the temperature was 110 degrees and was too hot to be wearing a coat and necktie, that all my clothing was on top of the bus and that I was hungry and wanted some food! This did no good whatsoever, and I ended up not getting anything from that place. Back I went along with the natives and ate along with them some more dried fish and that OTHER dried meat, some very hard bread, very dark and dirty looking stuff. I knew how it was to be not admitted in a high class place. I even tried offering them double prices to let me eat there. I DID NOT LIKE THIS TREAT-MENT AT ALL I must say. For over three or four days I did not see a white face. I was seeing Africa the hard way, this I must admit. At every country border the bus stopped and we all went in the little Custom House and always the questions were about the same. Did I have any firearms, did I have any ammunition, did I have any alcoholic drinks, did I have any tape recorders, did I have any TRANSISTOR RADIOS. My answer was of course NO to all these questions. At no one single check point was my baggage opened and inspected. All that radio equipment went all the way from Tanganyaki to Johanesburg, South Africa without once being opened! I guess they figured anyone traveling on an African bus could not have anything of value along with them. My first stop was with Shorty, VQ2EW (I think that's his call). with his nice wife. Shorty had plenty of cold Cokes in his Fridge (as they call it). I understand that Shorty and his wife are now back in ZS6 land where he was originally from. He drove me all around showing me the native quarters, market place, and I met

many of his friends there. Shorty and his wife were very wonderful hosts to me. I installed my equipment on his operating table and had many a fine QSO with my friends in the USA and other countries. I told them about the proposed trip to Bouvet and Tristan da Cunha and Gough Islands. Shorty had a fine Quad installed and boy it brought in the results with my rig connected to it. The SWR was quite high, about three or four to one as near as I remember, with no noticeable ill effects as far as I could tell. These fellows down there have some mighty fine openings to the USA. You should hear those S-9+++ sigs pouring through, hour after hour down there. I wish those same fellows would come through like that over here. I used to listen across the bands doing a little eave dropping on the fellows. Sometimes I would hear someone say, "I wonder where Gus is right now" and I would call them and say I am right here, "what can I do for you?" This kinda shook them up I suppose. But it was lots of fun. I got caught up on my eating at Shorty's home but time to depart arrived and away I was again, heading for Johanesburg on that African bus. It was the same old thing all over again only MORE SO! We passed the tremendous Zambazi Falls which to me looked a lot larger and more rugged than Niagara Falls ever looked. It was late in the afternoon when we stopped there and too late to take any pictures. I did take a few but none of them turned out on account of not enough light. We went through Southern Rhodesia and then through a portion of Bechuanaland (ZS9) without any stops except to eat. I had no chance to try to get a "operating permit" there on account of the tight schedule to get to Capetown for that Bouvet island boat trip. Bechuanaland was a very miserable looking spot, at least the portion we traveled through. After it came South Africa. It was the most dramatic change of scenery I have ever seen. It was like moving from Africa of the 1800's to modern-day America. Right at the border the rough washboard, unpaved road changed to a big wide asphalt highway. It sort of reminded me of half of the New Jersey Turnpike. Later on I found this type of road was to be found practically all over South Africa. That's it for this month fellows. BOUVET HERE I COME.

. . . Gus

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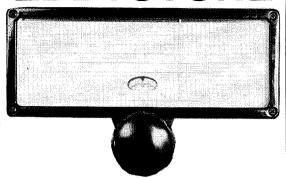
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WTW Certificates

Here is a complete list of all WTW recipients since the beginning of the program on May 1 1966. There were several errors in the list given last month that weren't discovered until the magazine was already on the press. This list is up to date with proper certificate numbers, band and mode.

14 MHz SSB WTW 200

- 1. Bob Wagner W5KUC
- 2. Gay Milius W4NJF
- 3. "Hop" Hopple W3DJZ

14 MHz SSB WTW 100

- 1. Gay Milius W4NJF
- 2. Bob Wagner W5KUC
- 3. "Hop" Hopple W3DIZ
- 4. Bob Gilson W4CCB
- 5. Jim Lawson WA2SFP
- 6. Joe Butler K6CAZ
- 7. Warren Johnson W0NGF
- 8. Lew Papp W3MAC
- 9. George Banta K1SHN
- 10. Dan Redman K8IKB
- 11. Paul Friebertschauser W6YMV
- 12. Jay Chesler W1SEB
- 13. James Edwards W5LOB
- 14. Bill Galloway W4TRG
- 15. Olgierd Weiss WB2NYM
- 16. Jose Toro KP4RK
- 17. Gerald Cunningham W1MMV
- 18. John Scanlon WB6SHL
- 19. Edward Bauer WA9KOS
- 20. Dick Tesar WA4WIP

21 MHz SSB WTW 100

- 1. Ted Marks WA2FQC
- 2. James Lawson WA2SFP
- 3. Joe Hiller W4OPM

14 MHz CW WTW 100

- 1. Vic Ulrich WA2DIG
- 2. James Resler W8EVZ
- 3. Dan Redman K8IKB

21 MHz CW WTW 100

1. Joe Hiller W4OPM

teurs working for the overall benefit of our group of hobbies. Well, damned few.

The idea seems to be let George do it. Well, there isn't any George.

Techs on Ten?

Still another letter asking why not Techs on ten meters. The complaint is that the Tech doesn't have any code practice available up on six meters and that when someone does try to send some code he gets cat calls from other Techs.

I never heard so much clap trap in my life. Any Tech . . . or anyone else . . . that wants to learn the code can do it the way most of us have done: sit down and copy it. You don't need a transmitter or even a license to learn the code. All you need is a receiver and enough gumption to sit there for a few days writing down all the tripe you can decipher until you can read it at thirteen per.

DXpeditions

Sometimes I wonder how DXing was thirty years ago, just before I came into ham radio, before the ARRL DXCC and Honor Roll came into being. I wonder if DX operators were hounded right off the air from every relatively rare spot by the QSL head hunters? I wonder if the great bulk of the DX contacts in those days were for the purpose of getting a QSL or were perchance for the joy of the contact itself?

Now that I've operated from dozens of countries around the world I realize that a kilowatt transceiver, a three element beam up 70 feet and a few days just for hamming will give me DXCC from anywhere in the world. And if I don't have to spend too much time working I can get up in the 300 plus country list in a year. I don't need much in the way of brains, though they help, obviously, or even any technical knowledge, just persistance.

Having DXpeditioned myself a bit and being on excellent terms with many of the top DXpeditioners, I don't want anyone to think that I am intending to be in any way critical of the chaps who put on DXpeditions. But . . .BUT. . . DXpeditions have brought on a very dangerous situation and, unless some major changes can be made in



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500 PRV	2.70	2.75	3.25
Tophats, Varicaps,	200 PIV. 08c; 400 new. 27, 47 or 100 PF	PIV, .12c;	600, .18c
\$10.00 ord	order \$3.00, plus post ler or more, pick any \$1	.00 item free;	5%. On a On \$25 or

Catalog ELECTRONIC COMPONENTS
P.O. Box 2902E, Bafon Rouge, La. 70821

LARGEST SELECTION In United States AT LOWEST PRICES—48 hr. delivery



Thousands of frequencies in stock. Types Include HC6/U, HC18/U, FT-241, FT-243, FT-171, etc.

SEND 10¢ for catalog with oscillator circuits. Refunded on first order. 2400B Crystal Dr., Ft. Myers, Fla. 33901



MODEL 400 AND 501

TV CAMERAS





From \$125.00

Each month we have a limited quantity of used TV cameras which we make available to hams at greatly reduced prices. Some cameras were used as demonstrators by our salesmen; others like our Model 400 were traded in for our 501. A few are back from being rented out on special temporary surveillance jobs. Some were modified slightly to fit the particular job and may have extra holes or vary slightly in appearance from the photos. All have been checked out and are guaranteed for 90 days. Complete with vidicon and lens.

Model 400 sale price \$125.00 FOB Hollis Model 501 sale price \$160.00 FOB Hollis

These used cameras are for sale to radio amateurs only. Include call letters with your order.

DON'T DELAY. ONLY A FEW ARE AVAILABLE EACH MONTH.

For specifications on the 501 see our other ad elsewhere in this issue. For specifications on the 400 see 1965 issues of 73.

VANGUARD LABS

196-23 Jamaica Ave. Hollis, N. Y. 11423 the DXCC rules, my present thinking is that all of us should do as little as we can to encourage them.

Whoa, don't jump to any conclusions. Not one of you reading this even have an inkling of what I am about to say, save perhaps the chosen few of you who have had the privilege of visiting some of the rarer countries and are familiar with their political problems.

Here and there around the world I've visited places or received letters from spots where a DXpedition has left some ruffied feelings. This happens, of course, but it is relatively rare and seldom does this result in any serious repercussions to local or following amateurs.

The real problem is this: in several countries around the world amateur radio is tacitly permitted, only don't ask for a license. A visiting amateur goes to the licensing authorities and is given a shrug. Go ahead and operate, but please don't ask me to sign anything because if there is any trouble I don't want the responsibility. It's like our own State Department, no one wants to be responsible.

All goes well. Our visitor goes on the air, contacts a few thousand stations, makes everyone happy, and departs for greener pastures. Then, sometime later, comes the bomb. A letter comes to the government from the ARRL asking if the amateur had a license. The letter stirs up a hornet's nest and the Minister of Communications, if he doesn't lose his job or even his head, is going to be mighty careful about saying yes to the next ham visitor.

The ARRL has decided, for some reason, that it is up to them in some cases to determine the validity of a DXpeditioners license. This, unfortunately, can cause grave international complications. And we certainly don't need any such problems right at our present time in history where we are waiting to see whether the countries of the world are going to get together and take our bands away from us. Right now we should be doing everything in our power to prove the value of amateur radio to the small countries of the world, not causing serious internal political complications through base stupidity.

Well, at any rate, since there is little possibility that the League is going to stop meddling with foreign governments, perhaps we should try to work from the other end of the street and do what we can to discourage DXpeditions from now on. This is simple, just stop sending those generous donations which are supporting the DXpeditioners. When the money stops the DXpeditions will stop. This is lot easier to stop than the ARRL and may be the better solution. The next time you reach for your checkbook just remember that you may be doing a lot more harm than good to amateur radio.

Public Relations

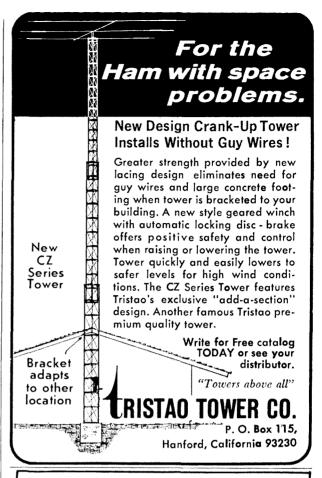
The number of licensed amateurs dropped by about 5% last year, the FCC has reported. Things slowed down coincident with the ARRL announcement of RM-499 and Docket 15928, the official outcome of 499, is coincident with the unparalleled loss of interest in our hobby.

What's done is done. We can hope that it won't happen again. The board of the ARRL moved last May to prevent something like this from surprising us by requiring that the ARRL executive committee check with the board of directors in the future before sending any further earth shaking petitions to the FCC. It's too bad that barn door wasn't closed before RM-499. The executive committee cooked up 499 and sent it along in without consulting the members or, apparently, even the full board of directors.

So, at a time in history when it would be most prudent for us to be fruitful and multiply we find that our ranks are thinning. We need strength today to hold our amateur bands. This means that continued growth is basic to our survival. Unfortunately there is little being done to promote our growth. Here we are, plunging into the electronic era, and the leading scientific hobby is withering away faster than it grew a few years ago. With over half of the population of our country under 21 we should be experiencing a record growth, with radio clubs starting in high schools all over the country.

What is the problem? You know as well as I. No publicity. Or at least very little publicity and no organized promotion at all. We should be making sure that the youngsters are made well aware of amateur radio and we should get cracking on this or we will be in deep trouble.

How can we get the word out? Lordy, we have one of the most interesting hobbies ever invented . . . all we have to do is just tell people about it. Right now we're not doing this. This is not a job for one man or even one radio club, it is the job of a large



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 Just Listen And Learn
- Based on modern psychological techniques—This course will take you beyond 13 w.p.m. In LESS THAN HALF THE TIME!

Album contains three 12" Also available on magnetic tape.

LP's 2½ hr. instruction See your dealer now!

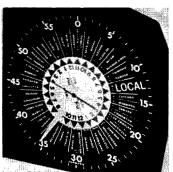
EPSILON TO RECORDS

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COMPLETE YOUR GEAR

TWENTY-FOUR CLOCKS IN ONE

MODERN
AS THE
SATELLITE
\$11.95



Model D-300

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When clock is accurately set in any local time zone the correct time is automatically shown in each of the other 23 zones.

Farmerie World Time-Zone Clock

CASE: wall or desk
22 ga. steel 8" x 8" x 2¾"
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Other models available

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73 Magazine CUMULATIVE INDEX

October 1960-December 1966

Now available for 25¢

73 Magazine

Peterborough, N.H. 03458

organization, one that is geared to handle something of this size.

The ARRL could, if it wanted to, reverse the tide. And it could do it this year. By increasing the membership dues by 50c per year or by increasing their advertising rates in QST by a mere 10% they could have a whopping fund to hire a good public relations firm which would make sure that the entire country knew about amateur radio is short order. We would be having articles on our hobby in all of the major magazines regularly . . . Look, Life, Post, Boy's Life, True, Playboy . . . and on down the line. A PR firm could coordinate the writing of articles and get them into magazines, newspapers and even on television.

Perhaps it is time you phoned your director and bugged him to get this going and going right now. We can't wait until 1968. This is not the time for a study or a committee, it is time for PR. The directors meet only once a year, in May, this month, so if they don't get this through right now they won't even have a chance until a year from now to start on it.

I can't go into all of the details here without writing a large book, but I think I can give a good answer to any possible argument that can be brought up opposing ham PR. For instance, should anyone suggest that the raising of membership dues by 50c will be catastrophic you might ask them if they are aware of the dues that most other national organizations charge club members. If you belong to any other clubs you know that most of them are \$10 to \$15 or so a year and this usually includes a smaller magazine than QST. And QST's advertising rates are about one third to one fourth those of any other magazine comparable in another field, so they could easily increase these rates anytime they felt any need for extra money.

It won't hurt a bit to talk up the PR thing on the air and get as many fellows as possible to call their director. There is no time to lose. Unfortunately most directors are "too busy" to get on the air so you'll have to use the land line.

In addition to the top notch writers in our ham ranks such as Jean Shepherd (K2ORS), the most published author in Playboy and winner for two years running of their coveted award for the best story of the year, we have the vitality of thousands of ham clubs. If the League were interested in pushing PR they would encourage clubs to pro-

mote ham programs on broadcast radio and television all over the country and to acquaint our public officials with our hobby. There is a tremendous job to be done.

It is all up to you. I'll be watching the fine print in QST for this year's report on the board of directors meeting to see what our future looks like.

Irrelevant Note

One of the nice things about living up here in the backwoods of New Hampshire is that you can go to a country auction every Saturday night. The darndest things turn up there. The other night I lucked into a bunch of those old wooden jig saw puzzles. I dig those the most and snapped them for a dollar. Back in the early thirties we used to rent them from Womrath's and our whole family would struggle over a thousand piecer on holidays. Then came those confounded cardboard puzzles, stamped out instead of hand cut. Ugh.

Now and then I rent a puzzle from an outfit in New York. It's nice when the bends are loaded on weekends. Say, if any of you have some of those wooden puzzles you're thinking of throwing out, even if a piece is missing, let me have a chance at it.

I'm also keeping a weather eye peeled for a pottery kiln, in case anyone around the East has one extra. I can swap a complete press for making QSL cards with a half dozen trays of type. Or what do you want?

And we're looking for a pet type Burmese kitten. That's about all.

... Wayne

Liberian Field Day

If you need Liberia for WTW, your big opportunity is just around the corner. The Liberian Radio Amateur Association will hold its Third Annual Field Day Activities on April 29 and 30. The club station EL2FD will operate SSB on 14303 and 21303 kHz from 1400 to 0100 GMT on Saturday and from 0900 to 0100 GMT Sunday. A CW station will be on 14103 kHz. The RTTY boys will have a chance too—that is if the teletype equipment at EL2FD will work. Look for them on 14090 kHz.

The purpose of this annual field day is to demonstrate amateur radio and encourage the local people to become hams. QSL cards will be sent to every station contacted. The QSL cards are on hand and will be filled out on the day of contact.

WANTED

SALES ENGINEERS EARN

\$20,000 per year

Based on commission from sales and installation of just 3 Vanguard TV cameras per week!

Full or Part Time

Closed circuit TV is recognized as a definite necessity for many businesses to combat rising costs. Thousands of factories, office buildings, banks and schools will welcome your demonstration.

Using our list of applications as a guide you will be able to show how any establishment can use several cameras and how each one can save thousands of dollars through the resulting increase in efficiency and security.

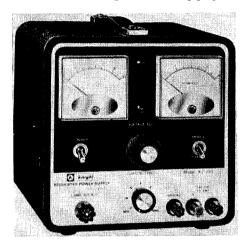
If you are over 21, have a working knowledge of TV and are financially responsible, we need you as a sales engineer to demonstrate our Model 501 in your area. To receive your application and additional details, send us a resume of yourself and include a self-addressed, stamped envelope.

VANGUARD LABS

196-23 Jamaica Ave. Hollis, N. Y. 11423



Knight-Kit Solid-State Regulated Low Voltage DC Supply



The new Knight-Kit solid-state power supply, with continuously variable 0-40 volts DC and 0-1.5 amperes output, provides an ideal source of power for transistor circuit development in the shack. This power supply, the model KG-663, is regulated for both line and load variations and features variable current limiting which automatically limits short-circuit current to a safe value. Two meters on the face of the supply simultaneously monitor voltage and current. A heavy-duty operation/standby switch allows presetting of output voltage with the load disconnected; pilot lights indicate standby and operate conditions. This supply also has fine and coarse voltage controls, a rear terminal strip for remote programming and sensing and isolated plus and minus voltage. These units are designed so that they may be stacked for series/parallel use.

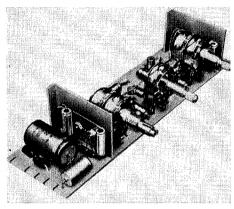
The KG-663 supply is very well filtered and regulated for low ripple output; less than 0.6 millivolts rms at full load. It is available in kit form for \$99.95, or completely factory assembled for \$149.00 from Allied Radio Corporation, 100 N. Western Avenue, Chicago, Illinois 60680.

Apollo Tie Clasps and Desk Plaques

Apollo Engraving, 191 N. Hickory Street, North Massapequa, New York 11758, is marketing a new line of tie clasps which are very neat and attractive and would make nice gifts and awards. Selling, delivered, for only \$1.50, the background is black, call letters white, and there is a commercial mike attached to the edge, giving it a very professional appearance.

Apollo also makes call letter desk plaques, on laminated plastic board 2½ x 6 inches, in black, mahogany, walnut or blond oak, with white call letters, and mounted on a clear plastic base with a metal edges, looks great on the operating table. This sells delivered for only \$2.50.

Amperex Printed Circuit Assemblies and Kits



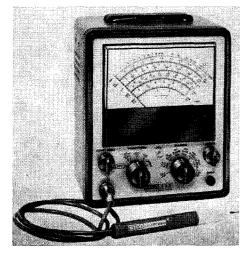
Amperex Electronic Corporation has just announced the introduction of a broad line of printed circuit assemblies and kits for the experimenter and hobbyist. The printed circuit assemblies are available for immediate distribution and the kits will be ready for June deliveries. These new units are designed for use in ham gear, home entertainment equipment, public address and intercom systems. Printed circuit assemblies presently available are 1 watt, 2 watt, and ³/₄ watt amplifiers using either 9 or 14 Vdc, several models of stereo amplifiers, a tape preamplifier and a 20 watt monaural amplifier. The amplifiers are available in various configurations that include tone controls, balance controls, no level set controls; an arrangement is available to suit nearly any requirement. For further information, write to Amperex Electronic Corporation, Semiconductor and Receiving Tube Division, Distributor Sales Department, Hicksville, Long Island, New York 11802.

Lafayette Spring Catalog

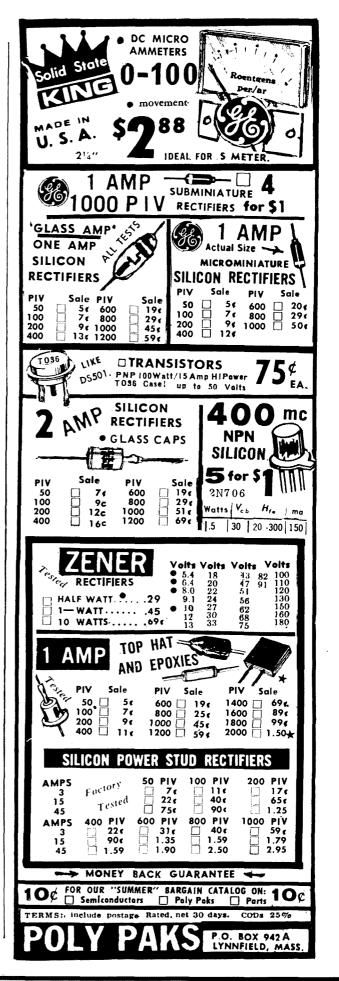


Layfayette has just announced its new Spring 1967 catalog with the latest in electronics and hi-fidelity. All of Lafayette's own top-rated components as well as equipment from many of the top manufacturers are represented plus a special six page clearance section with a host of values. There is a complete selection of ham gear, test equipment, tools, hi-fi components and electronics parts included. For your free copy write to Lafayette Radio Electronics Corporation, 111 Jericho Turnpike, Syosset, Long Island, New York 11791 and ask for catalog number 673.

Eico Professional VTVM



One of the many capabilities of the New Eico Model 235 Professional VTVM is accurate measurement down to 0.01 volts. This



SPRING DEMO SPECIAL SAVE

Drako TR4 .	\$489	Swan 250\$289
Drake R4A .	\$330	Ham/M w/c\$ 95
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Calary 9000	\$395	Mosley TA33\$100

See Bill Ogg WA9RMO or Dave Clarke WA9RFK EVANSVILLE AMATEUR RADIO SUPPLY 1306 E. Division St., (812) 422-4551 Evansville, Indiana 47717

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TELETYPE MODELS 28 ASR, 28 KSR, 28 LPR, 28 LARP, 28 LXD, 28 LBXD1, 14, 15, 19, Page printers, Perforators, Reperforators, Transmitter-distributors, Polar Relays, Collins Receivers 51J-3, R-388, 51J-4, R-390A. Hammarlund SP-600JX. Frequency Shift Converters.

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HERE'S A PERFECT MATCH

Now you can get a perfect match for Hy Gain two-meter models 23, 28 and 215. This is an L-match ar-rangement that gives 1.0S to 1.00 SWR at the antenna. Only \$2.50 ppd. Send for the L-Match to:

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PLATE TRANSFORMERS—\$39.95

3600-0-3600 VAC @ 1000 Ma., CCS, with 120/240 VAC 60 cps primary. Commercial quality units manufactured by Wagner Electric Co. measure 13" high, 12" wide, and 9" deep. Net weight is B5#. Price \$39.95 F.O.B. Minneapolis. One year unconditional money back guarantee. Terms: Check or M.O. with order. Immediate delivery. Write or phone: PETER W. DAHL CO.
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MILITARY TEST EQUIPMENT DATA HANDBOOKS

Published 1961 by Fredereick Research Corp. Vol. 1. Volt/ Current Meas. Equip. Vol. 2. Freq. Meas. Equip. Vol. 3. Waveform (Oscilloscope) Equip. Vol. 4. Signal Gen. Equip. ment. Four Bound Books (10 pounds) NEW. \$5.50 postpaid. payment w/order. We Also buy for Cash. Surplus Testsets, Transmitters, Receivers, Etc. Especially Airborn Collins.

RITCO Electronies, Box 156, Annandale, Va. 22003. Phone (703) 560-5480.

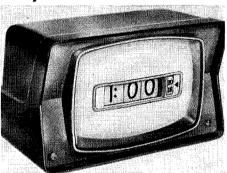
A.R.C. Sales

A.R.C. Sales P.O. Box 12, Worthington, Ohio 43085 type of measurement is particularly useful when working with transistor circuits.

Operation of the instrument is made easier and more efficient by using a unique twocolor system of coding and coordination on the range and function switches and meter face. The dual purpose AC/DC Eico Uni-Probe also simplifies matters when making many measurements. Its 11 megohm input impedance makes for negligible loading in precision DC measurements from 0.01 volts to 1.5 kV in eight overlapping ranges. Both peak to peak and rms voltage are read on separate scales in seven overlapping ranges up to 1500 volts rms (4200 volts p-p). The basic frequency response of this instrument is 30 Hz to 3 MHz, but it may be extended to 250 MHz with an optional high frequency probe.

For further information on this versatile new VTVM, write to Eico Instrument Company, 131-01 39th Avenue, Flushing. New York 11352.

Tymeter Numeral Clock



If you don't have a numeral clock in your shack, the new Tymeter Colorama Tele-Vision Lamp Clock may be just what you're looking for. This clock has a good looking face and is available in several color combinations that will fit any decor; persimmon/white case, walnut case, or white case, priced respectively at \$14.95, \$13.95 and \$13.95. These clocks have a built-in light and come with a one year guarantee.

While time has been measured by mechanical clocks since 1363 when Henry De-Vick invented the earliest self-contained counterpart of the modern clock, reading dial faces results in loose time-telling. For amateur radio work, accurate time is a must, and with the numerical clock it's a snap. Write to Pennwood Numechron Company. Tymeter Electronics, 7249 Frankstown Avenue, Pittsburgh, Pennsylvania 15208 for more information.

Amperex Power Tetrodes

Do you want a single sideband linear that will really loaf along at the legal limit? The new Amperex 8679 and 8744 should fill the bill. Both of these tetrode power tubes were designed for use as low distortion linear amplifiers in class AB single sideband service and are rated at 4 kW and 10 kW respectively.

Under class AB conditions the 8679 will produce 5 kW PEP output with odd order distortion products down at least 35 dB. The 8744 will produce 10 kW PEP output with the same order distortion products in single sideband linear service. If you want the coolest linear in town, write to Amperex Electronic Corporation, Tube Division, Hicksville, Long Island, New York 11802 for full specifications and prices.

ATV Research Television Catalog

The new ATV Research Television Catalog is just chock full of goodies for the amateur television enthusiast. This catalog features a brand new transistor television kit, transistor camera parts for "do-it-yearself" experimenters including focus-deflection coil kits, tripods, lenses and all types of vidicon camera components. If you want to get on the ATV bandwagon, this catalog lists everything you need to get your station going. For a free copy, write to ATV Research. Post Office Box 396, South Sioux City, Nebraska 68776.

Silicon Controlled Rectifiers

Allan Lytel's new book on SCR's gives a complete explanation of these important new semiconductors. They are being used in new applications everyday because of their small size, versatility and reliability. This book thoroughly explains their principles of operation and illustrates how they may be used in numerous practical control circuits.

Phase-shift control of ac and dc power is clearly explained and examples of these circuits given. This book also discusses SCR ring counters, temperature controls, and voltage regulators. The chapter on SCR testing will be particularly useful to anyone working with SCR's. \$2.75 at your dealer or write to Howard W. Sams & Company, Inc., 4300 West 62nd Street, Indianapolis, Indiana 46206.

BC-603 RECEIVER

BC-603 REC. CONVERTED

To 30 to 45 MC. Used: . . .\$44.95

AC POWER SUPPLY f/BC-603: Wired \$14.95. Kit \$10.00

DM-34 Dynamotor for 12 Volt DC operation ... New: \$4.95

DM-36 Dynamotor for 24 Volt DC operation ... New: \$4.95

Prices F.O.B. Lima, O.—25% Deposit on COD's—Minimum Order \$5.00—CATALOG: Send 25c, Receive 50c credit on

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CQ de W2KUW 5% BONUS!!

Paid over any top offer for any piece of aircraft or ground radio units, also test equipment. All types of tubes. Particularly looking for 4-250 • 4-400 • 833A • 304TL • 4-1000A • 4CX5000A et al. 17L • S1X • 390A • ARM • GRM • GRC • UPM • URM • USM TED DAMES CO. • 310 Hickory St., Arlington, N.J.

WE WANT TO BUY Surplus Aircraft Radio & Test Equipment

We will pay cash or trade you (whatever you need) for the following items:
Test Equipt. Signal Generators.
Measurements Corp. Models 65-B
Boonton Radio Co. Models 68-B
Boonton Radio Co. Models 68BD, 612A, 624C.
Military Models. SG-1A, SG-2, SG-13, SG-66A, MD-83A, TS-510A.
Aircraft Navigation & Communication Equipt.
ARC-34, ARC-38, ARC-52, ARC-73, ARN-14, ARN-59, ARN-73.
Aircraft Instruments.
ID-249A, ID-250A, ID-251A, ID-351A, ID-387.
We also want late type Aircraft Radio and Radar equipment manufactured by Collins Radio Bendix Radio and Aircraft Radio Corp.

Aircraft Radio Corp.

Write, Wire or Phone if you can supply any of these. Ask for Norm Eichner.

Norman Electronic Sales

Chicago, III. 60626 1413 Howard St.

MACO QUAD — FOR 10-15-20
Uses SHAKESPEARE FIBERGLAS WONDERSHAFT® Optimum spacing—.15 on all bands—
[1] RG-8/U quad complete—\$99.95—WRITE
FOR FREE BROCHURE

Maco Products
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See our previous ads in April, May and June 1966 73's.

WE BUY . . . FOR CASH UNITY ELECTRONICS

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- ★ Price—\$2 per 25 words for non-commercial ads; \$5 per 25 words for business ventures. No display ads or agency discount. Include your check with order.
- ★ Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.
- ★ We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.
- ★ For \$1 extra we can maintain a reply box for you.
- ★ We cannot check into each advertiser, so Caveat Emptor . . .

DUMMY LOAD 50 ohms, flat 80 thru 2 meters, coax connector, power to 1 kW. Kit \$7.95, wired \$11.95. pp HAM KITS, Box 175, Cranford, N.J.

28 CIRCUITS BUILD: liquid level control, burglar alarm, weather detector, trick circuits, fire alarm, etc. Booklet and special relay \$3.95 prepaid. Alco, Dept. E, Lawrence, Mass.

TOROIDS—DIODES—COAX—CONNECTORS. 88 mH toroids—45¢ each, 5/\$2.00. 1000 PIV 1 Amp Top-Hat Diodes—55¢ ea, 2/\$1.00. Connectors, PL259, SO-239, M359—45¢ ea, 10/\$4.00. Button feedthroughs (while they last) 500 pF @ 500 V. 20/\$1.00. Add sufficient postage. R & R ELECTRONICS, 1953 S. Yellowspring Street, Springfield, Ohio.

VARIACS—General Radio and Ohmite. 60 cycles, Input 120V—output 0-280 V. 1 amp or input 240 V—output 0-280 V. 2 amp. PULLOUTS IN GUARANTEED EXCELLENT CONDITION \$6.95 plus postage. Shipping weight 10 lb. R & R ELECTRONICS, 1953 S. Yellowspring Street, Springfield, Ohio.

CHRISTIAN HAM FELLOWSHIP is now being organized. For free details write Christian Ham Fellowship, Box 218, Holland, Michigan. (Christian Ham Callbook \$1).

WANTED—Teletype 28s, parts, what have you. SELL—machines, parts. Fred Schmidt, W4NYF, 405 NW 30th Ter., Ft. Lauderdale, Fla. 33311. 305-583-1340 (9 P.M. EST.)

TOOOOBES: 811A—\$4.25; 7094—\$26.90; 6146A—\$2.25; 6CW4—\$1.40; 5894—\$15.50; Extra power 6146B—\$4.00; 6360—\$3.45; 8236—\$9.50. All new, boxed, guaranteed. FREE catalog. VANBAR Distributors, Box 444Y, Stirling, N.J. 07980.

VALIANT I transmitter, 75A3 receiver, both \$375. Consider separate sale. K3BEM, 2514 Kittery Lane, Bowie, Maryland 20715.

TEN METER SIGNAL GENERATORS, \$5.95 each. Postpaid. Crystal controlled tone modulated. On PC board. 2 x 5 inches. Like new. Tested. Your choice in 10 kHz steps. 28.615 to 28.905 MHz. Less battery and switch. Specify frequency. Sorry, no COD. Wayne Lafayette, 5429 North Detroit St., Toledo, Ohio 43612.

25 WORDS FOR \$2. Sell or buy through these want ads, a terrific bargain. Caveat Emptor, 73 Magazine, Petersborough, N.H. 03458.

NOVICE AND TECHNICIAN HANDBOOK by W6SAI and W6TNS. Limited quantity for only \$2.50 each. 73 Magazine, Petersborough, N.H. 03458.

RTTY GEAR FOR SALE. List issued monthly. 88 or 44mH toroids five for \$1.75 postpaid. Elliot Buchanan, W6VPC, 1067 Mandana Blvd., Oakland, California 94610.

ESTATE SALE and bargain list. Send for it and include SASE. Write Paradd Sales and Engineering Service, 280 Route 10, Dover, N.J. 07801.

ROCHESTER. N. Y. is headquarters for Western New York Hamfest and East Coast Spring VHF Conference, Saturday, May 13. Top programming plus huge "flea" market. For more information, write: Rochester Amateur Radio Assn., P.O. Box 1388, Rochester, N.Y. 14603.

COMPLETE CONVERSION instructions for the AN/VRC-2, just \$1 while the supply lasts. 73 Magazine, Petersborough, N.H. 03458.

PLASTIC HOLDERS—each display 20 QSL cards. 3 for \$1.00 or 10 for \$3.00 prepaid and guaranteed. Free brochure of other ham goodies included. Tepabco, Box 198N, Gallatin, Tennessee 37066.

525 LINE CCTV COMPLETE, with diagrams. Vidicon and three tubes in camera, 12" monitor with picture and 7 tubes, synch chain unit with ten tubes, synch mixer and video amplifier unit with 13 tubes, power supplies electronic with 8 tubes and 4 selenium rectifiers. All you need is a modulator to go on the air. I need 75' to 100' tower (rotatable), 75A4, 391 or similar receiver and other offers. Cash price \$1800. Will also consider 4-5 element monoband beam for 10, 15 and 20 meters. H. K. Schwill DL6CL/W2, 723 Plainfield Ave., Berkeley Heights, N.J. 07922.

ETCHED CIRCUIT PROJECTS from 73! Send your name, address and a 4¢ stamp for a catalog of etched circuit boards from the Harris Company, 56 E. Main Street, Torrington, Conn.

HAMMARLUND HQ-129X and Heath speaker, Central Electronics 20A with model 458 VFO and Heath Q multiplier. Best offer for the lot. Dick Acker W9TOK, 5434 S. Kostner, Chicago, Ill.

GONSET 903A two meter 500 watt linear amplifier. Like new. Will deliver within reason. \$200. Dick Hart K0MQS, Box 667, Cedar Falls, Iowa. 319-266-6126

COLLINS 32S1 and 75S1, good solid state power supply, for sale. Ken K6MVN, 3595 Hampton Road, Sierra Madre, Calif. MU 1-5915.

SB34, new Sideband Engineers (Raytheon) transceiver, 80-40-20-15 crystals, coils, antenna, complete. Won prize, not needed. 30% discount, or will trade for recording equipment or marine transceiver. Carl Wilson W6GV, 4150 Santa Monica, Los Angeles, Calif. 90029.

TRADE HP130B scope, Hickok 288X AM-FM signal generator, HP 200B audio generator and HQ-110C for 388-51J3 receiver. John Chaplin, 703 S. Dixon Rd., Kokomo, Ind. 46901.

UNIQUE relay to build variety of remote controls, model railroads, liquid level control, weather detector, burglar alarm, games, trick circuits. 20 design ideas included free. 3.95 prepaid. Dept. E., Alco, Lawrence, Mass.

WANTED: Teletype model 28, in first class condition. Prefer with keyboard and geared for 65 and 100 wpm. N. Oland, Box 134, Blue Bell, Pa. 19422

DRAKE 2-B, 2-AC, and 2-BQ, \$189.00. Eico 720 transmitter and 722 VFO, \$65. With manuals. WA6STA, George Loetz, 1441 Kerrick, Lancaster, Calif. 93534. Telephone 805-942-9434.

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COLLINS 75A-1 receiver, 270-G speaker, excellent \$150. 6 meter HE45-B, Turner P-T mike, HE-61 VFO, 6 meter squalo, all for \$75. Heathkit sweep generator \$15. RCA VTVM \$15. Heathkit VF-1 \$10. Want to buy Drake 2B, 2BQ, 2AC. A3/C Brian Kassel, 3410 Sq. CMR #5, Box 26334, Keesler AFB. Mississippi 39534.

TRANSISTOR CLEARANCE all types including VHF-UHF and audio. 2N522, 2N406-8 @ 5/\$1. 2N388, 2N321-3, 2N1370-4 @ 4/\$1. Assortment, 25/\$1. WA5FYF, 4336 Livingston, Dallas, Texas 75205.

TDQ 2 meter transmitter 165W \$80. Also NC300 receiver, good, all bands \$100. Call or write Gregory Crossman, 1320 Odell St., Bronx, N.Y.

PAINSTAKINGLY assembled Heathkit SB-400. First check for \$240 gets it. Ship prepaid USA. Casmaer, 7527 Astoria Place, Goleta, Calif. 93017.

SOUTH TEXAS Emergency Net annual convention on June 16-18 at Kerrville, Texas. Contact W5LVC, 638 Collingswood, Corpus Christi, Texas.

COLLINS 32-V2 excellent, spare 4D-32, other extras. Hammarlund HQ-170A with 24 hour clock, new condition. Certified check \$400. R. Schwendt W2ZEW, 5 Brook Lane, Bordentown N.J. 08505. 609-298-1493

HW 32 with Dynalab tri band conversion, needs alignment, \$125. WB2IDQ, RR #2, Cuba, N.Y. 14727.

THE DX ARE COMING—Spring is antenna time. Every balanced array that is fed with coax needs a balun. The Ami-Tron Kilowatt Toroid Balun Kit can be wired for 1:1 or 4:1 and comes complete with Illustrated Encouragement for only \$5.00-Get one today at your local radio store or order factory direct. Please allow 35¢ for Packing and Postage. Our baluns are guaranteed to do what we say they will do or your money back. Ami-Tron Associates, 12033 Otsego Street, North Hollywood, Calif. 91607.

SCARC Hamfest June 18th 0900-1800 near Mountain Playhouse, Route 219, Mile north Jennerstown. Entertainment, Restaurant, Displays, Prizes. Further information K3PQK, Box 17, Ursina, Pa.

EICO 753 TRI-BAND TRANSCEIVER with solid state VFO, 751 AC power supply and EV 719 mike—\$250. WB6RSV, 937 E. Glenoaks Blvd., Glendale, Calif. 91207.

"HAM-JAMBOREE" at WRL May 20th, 1967, 8 "HAM-JAMBOREE" at WRL May 20th, 1967, 8 AM to 5 PM, CDT. Manufacturers displaying include Swan, Galaxy, Gonset, Waters, Collins, National, and more. Prizes include at least three transceivers, (ie, Swan 500, Gonset GSB6, NC200, etc.), plus many more. No cost involved. Special prices on many items. Visit WRL at 3415 W. Broadway St., Council Bluffs, Iowa.

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SOMERSET COUNTY HAMFEST is being held at the Green Gables, Jennerstown, Pa. on June 18th. Come on out and join the fun—door prizes and awards. Write to Harold P. Showman W3PVG, 339 W. Garret Street, Somerset, Pa. 15501 for more details.

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YOUR CALL LETTERS: "3 Inch Silver Reflective" and Heavy Clear Plastic Standard; \$3.95 post paid. C. B. Plastic Products, Route 3, Grand Ledge, Mich. 48837.

HAM-TV. Vidicons, RCA 7735A, \$15.00; GEC 7325—test—\$7.00; Toshiba 7038, like new, \$35.00; "C" mount lens—f/1.9, \$25.00; TV camera—complete \$175.00; 15.75 kc crystal, \$14.00; Eimac sockets for 4X250B tubes—\$3.50; new Amperex 5849 with socket—\$9.00. WB2GKF, Stan Nazimek, 506 Mt. Prospect Ave., Clifton, New Jersey 07012.

WANTED: TEST EQUIPMENT, laboratory quality such as Hewlett-Packard, General Radio, Tektronix, etc. Electronicraft, Box 13, Binghamton, N. Y. 13902. Phone: (607) 724-5785.

SOUTHERN NEVADA AMATEUR RADIO CLUB thanks participants and exhibitors who made "SARCO", the "FUN-CONVENTION", such a success in 1967. Stellar Industries, E G & G, Southern California Edison Company, Brad Thompson Industries, Mission Ham Supplies, California Highway Patrol, Henry Radio, Trisato Towers, Weatherbie Electronics Center, Swan, Tri-Ex Towers, Collins, Hallicrafters, Superior Engraving, Hy-Gain, Radio Products, Linear Systems, Hotel Sahara, MARS, Raytheon, United States Airforce, WCARS-7255, W7SAI. "SAROC" 1968 "FUN-CONVENTION" will be centered in the heart of the entertainment capital of the world at Hotel Sahara, Las Vegas, Nevada, January 4-7. QSP, QSL-card, ZIP and telephone number for details to Southern Nevada Amateur Radio Club, Box 73. Boulder City, Nevada 89005.

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ROCHESTER, N.Y. is Headquarters for Western New York Hamfest, Saturday, May 13. Top programming plus huge "flea" market. For more information write: Rochester Amateur Radio Assn., P.O. Box 1388, Rochester, N.Y. 14603.

EAST COAST Spring VHF Conference will be held in conjunction with Western New York Hamfest, Rochester, N. Y., May 13. Full day of VHF programming. For more information write: Rochester Amateur Radio Assn., P.O. Box 1388, Rochester, N.Y. 14603.

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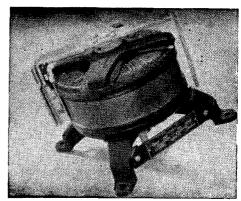
HAMFEST. The 7th Annual Streator Radio Club Pre Starved Rock Hamfest Dinner will be held June 3 at 7:00 PM at the Grove Supper Club. Tickets \$3.50 per person. Reservations must be in by May 21, 1967. Write to Thomas Blakemore, 605 W. Stanton Street, Streator, Illinois 61364 for further information.

KWM-2 with rejection tuning and AC supply \$750; TR-4 with unused DC-3 and homebrew AC supply, \$550. Going "S-Line." WA2LIM. 212-428-6133.

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200	1.50	6.00		800	3.40	12.00
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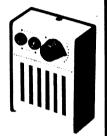
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EASTERN UNITED STATES TO:

GMT:	00	02	04	06	ÚB	10	12	14	16	18	20	22
ALASKA	14	14	14	7.8	7	7	7	14	14	14	14	14
ARGENTINA	21	21	21	14	14	7	14A	21	21	zl	21A	21A
AUSTRALIA	21	21	14	14	2В	7B	14	[4	14	78	14	l-i
CANAL ZONE	21A	21	14A	14	14	14	21	21	21	21A	2lA	21A
ENGLAND	14	14	7A	7A	7	14	14	14	14	14	14A	14
HAWAII	21	14	14	14	7	7	14	14	14	14	14	14
INDIA	14	14	78	7B	78	.14	14	14	14	14	14	14
JAPAN	14A	14	14	7B	7B	7B	14	14	14	14	14	14
MEXICO	21	14	14	7A	7	7	14	14	14	14	14	21.
PHILIPPINES	14A	14	14	713	713	7 B	14	14	14	14	14	14
PUERTO RICO	21	14	14	14	7	14	14	14	14	24	21	-21
SOUTH AFRICA	14	7A	7	14	14	21	21	21	23A	21	21	14A
U. S. S. R.	14	7A	7A	7A	7	14	14	14	14	14	14	14
WEST COAST	21	21	14	14	7	7	14	14	14	14	14	21

CENTRAL UNITED STATES TO:

ALASKA	14	14	14	14	7	7	7	14	14	14	14	14
ARGENTINA	21	21	21	14	14	ï	14	21	21	21	21A	2lA
AUSTRALIA	31	21	14	14	14	78	14	14	14	7B	14A	21
CANAL ZONE	21A	21	14A	14	14	14	14	21	21	21A	21A	21A
ENGLAND	14	7A	7A	TA.	7	7A	14	14	14	14	14A	14
HAWAII	21	51	14	14	14	7A	7A	14	14	14	14	21
INDIA	14	14	14	7A	78	78	14	14	14	14	14	14
JAPAN	14	ыл	14	14	7B	7B	7B	14	14	14	14	14
MEXICO	14	14	14	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14A	14	14	7B	7B	7B	14	14	14	14	14
PUERTO RICO	21	14A	14	14	7A	7A	14	14	21	21	21	21A
SOUTH AFRICA	14	7A	7	7A	7A	14	14	14	14A	14A	21	14A
U. S. S. R.	14	7A	7A	7A	7	7A	14	14	14	14	14	14

WESTERN UNITED STATES TO:

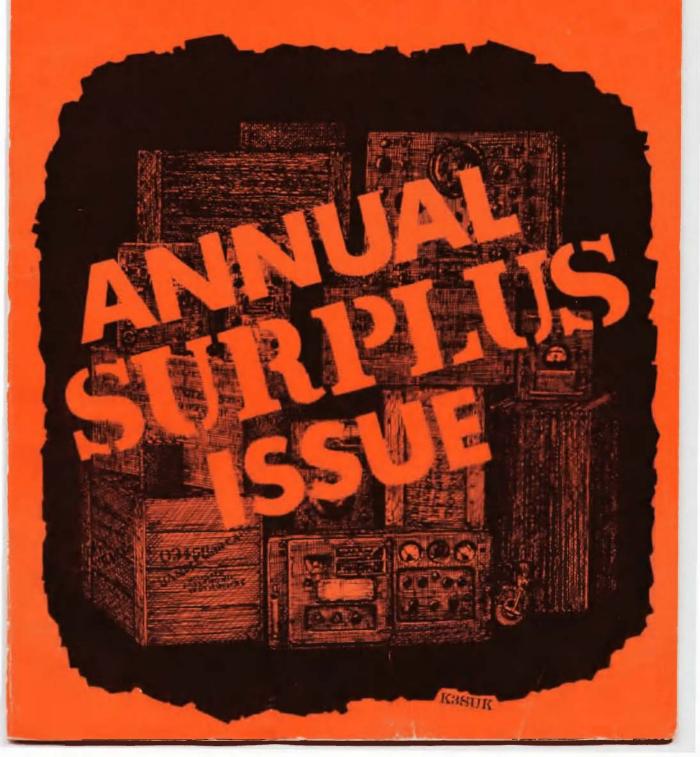
ALASKA	14	14A	14	14	14	7	7	14	14	14	14	14
ARGENTINA	31	21	21	14	14	7	14	14	21	21	21A	2lA
AUSTRALIA	28	28	28	21	21	14	14	14	7	7	14A	21A
CANAL ZONE	28	21	14	14	1.4	14	14	14	21	21	21A	28
ENGLAND	14	7A	7A	7	7	7	7	14	14	14	14	14
HAWAII	2lA	28	2lA	21	14	14	14	14	14	21	21	21A
INDIA	14	14	14	14	14	7B	7B	7B	14	14	14	14"
JAPAN	14	14A	14A	14	14	14	7	14	14	14	14	14
MEXICO	14	14	14	7A	7	7	7	14	14	14	14	14
PHILIPPINES	14	21	14A	14	14	14	7	14	14	14	14	14
PUERTO RICO	21A	23	14	1-;	14	14	14	14	14	21	21	21A
SOUTH AFRICA	14	7.B	7	7A	7B	7B	14	14	14	14	14A	14A
U, S, S, R,	14	14	14	14	7	7	7	14	14	14	14	14
EAST COAST	21	21	14	14	7	7	14	14	id	14	14	21

- · Very difficult circuit this hour.
- * Next higher frequency may be useful this hour.

73

JUNE 1967

AMATEUR RADIO



73 Magazine

June 1967

Vol. XLVI, No. 6

Jim Fisk WIDTY Editor

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The View from Here . . .

With all the technological advancements that have been made in amateur radio in the past few years, there's no reason why we must perpetuate antiquity by using AM on any of the high-frequency bands.

I'm sure this will evoke a few cries from isolated corners, but the fact is, if you listen in on the bands below 30 MHz at any time of the day or night, AM stations in the American phone band are few and far between.

Ten years ago it was the other way around—sideband stations were in the minority. Even five years ago the gentlemen's agreement on twenty meters was useful—now it is ridiculous. The two or three AM stations operating between 14200 and 14250 do a lot of complaining about the sidebanders' violation of this archaic agreement, but they're the only AM stations on the band. Everyone else has gone to more efficient and compatible sideband.

When king spark was outlawed in favor of CW and modulated oscillators were eliminated from the high-frequency bands, there were cries of anguish from a few who had fallen behind the times. The same thing is true today. There are always a few who fail to keep the pace.

The spectrum that we have available is limited and there's not a chance in the world that it will be enlarged. There's even a good possibility that we'll lose part of it. At the very best we'll have to contend with more and more intruders. Therefore, it's incumbent upon us to use the space we do have available to the best advantage. Maximum utilizations of the bands available, cannot, within any stretch of the imagination, include the use of Ancient Modulation. Most amateurs are aware of this and have switched to sideband.

Not only do AM transmitters require much more bandwidth, they are inefficient and in many cases, ineffective. This has been proven many times in the past, both theoretically and practically. If you can copy a station Q5 on CW, about 90% of the time you can make a successful contact on sideband. Don't try it on AM-90% of the time you won't make it.

Although spectrum utilization and interference are the two big arguments against AM, there is one other important consideration—state-of-the-art. In years past, amateurs donated much to the advance of the radio art. As our technology sky-rockets forward, there doesn't seem to be an awful lot that the backyard experimenter and amateur can contribute. However, we can use the best techniques that are available—this doesn't include AM; it went out with 872 rectifiers, general coverage communications receivers and swinging links.

A lot of the AM procrastinators will holler about the high cost of sideband. Bunk! You can buy a high-frequency sideband transceiver today from five or six prominent manufacturers for about the same thing you paid for a good communications receiver a decade ago. If you don't like transceive operation, remote VFO's are available from most of the same manufacturers for less than a hundred dollars.

Kilowatt power amplifiers are no problem either—if it will work on AM, a few modifications will turn it into a linear. In most cases all that is required are a few changes in bias. While all tubes were not designed for linear operation, most of them will perform pretty well when properly biased.

Furthermore, the conversion of an AM transmitter to double sideband is a relatively easy operation. Although double sideband uses twice the bandwidth of single side-band, it has at least the same efficiency and the troublemaking carrier is eliminated. widespread use of single sideband has pretty much inhibited any serious experimentation with double sideband, but it appears to offer at least one advantage-synchronous detection. When a properly designed double sideband system with synchronous detection is used, QRM free QSO's are apparently the rule rather than the exception. Not that I'm advocating double sideband-I just think it deserves more investigation.

It doesn't really make a great deal of difference whether we use one sideband or two —either system is compatible with the other. Actually, there is little danger that double sideband will ever be very popular; single sideband equipment is too readily available.

None the less, AM is not compatible. It's not compatible with sideband, nor spectrum utilization, nor state-of-the-art. It's inefficient and ineffective. Isn't it about time we eliminated it from the high-frequency bands?

Jim, W1DTY

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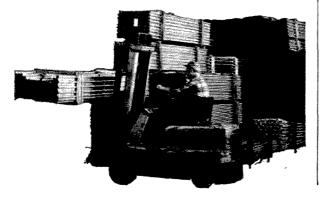
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Letters

The Price of Progress

Dear 73:

... A few months ago I subscribed to 73 and had a rude awakening. I did not know the language well enough to read half the articles. Progress had run ahead of me and I was in bad shape. Since that time I have been trying to catch up and it's rough . . .

Just wanted you and your associates to know that you are greatly appreciated and I think you are doing a great job for the fraternity. Maybe some of the youngsters like to buy ready-to-operate, but there are still some of those left around that like to experiment and build our own. Again, thank you very much for the fine job you are doing. Keep up the good work.

Emery White, Sr. W4TQD Glasgow, Kentucky

Dear 73:

. . . Your magazine is getting better all the time and you may yet make a technician out of a mathematician. Hi.

John Bauer Kanata, Ontario, Canada

ORP

Dear 73:

The following might be of interest to younger hams and perhaps refresh the memories of some of the old timers. The following input powers were taken from QSL cards received from stations worked on 28 MHz in 1948. My call was then KZ5RS: OZ8J—12 watts; ZL1DW—70 watts; ZS1CG—25 watts; OQ5HL—60 watts; GM3BON—35 watts; and VK3PG—50 watts. My reports to these stations were 57 or better.

R. W. Stewart WA4EKF Warner Robins, Georgia

The sunspots do make a difference.

Transistor Circuits

Dear 73:

Congratulations on your article by W1DTY—too bad you cut off the "T" in his call on the front cover of the March 73. His 73 transistor circuits are going to be a big help to this ham and a lot of others I am sure.

S. R. Gross W90JI Wheaton, Illinois

Dear 73:

. . . the transistor circuits article in the March issue was a real dandy and received a lot of favourable comment from the boys around here.

George Cousins VE1TG Nova Scotia, Canada

Dear 73:

Only two tubes in the March issue—what did you do, fire the drawer of tube diagrams? If so, FB. Promote Fisk for his solid state jewel!

Ev Taylor W6DOR Sacramento, California

(turn to page 126)

The Whole of The Doughnut

How to use toroidal tank coils in high power amplifiers for increased efficiency with reduced size. Practical inductors are shown for 100, 500 and 1000 watts.

Toroid rf tank coils have brought a new era of construction technique to the amateur builder as well as commercial manufacturers. Spurred on by modern requirements for compact construction, the toroid has seen recent applications in DC to DC power converters, interstage audio transformers, and many other uses. Indeed, the largest single application of the toroidal coil is the television flyback transformer which has been taken for granted for years in the home TV set. Recent articles have described toroidal coil applications in VFO's,1,2,3 low power transmitters,4 VSWR meters5 and multi-band tuners6. Now, for the first time, the outstanding advantages of toroids have been realized in higher power transmitter rf tank circuits.

The impact of toroids upon modern electronic equipment design has been of first order importance. Not since the advent of transistors or SSB itself, has so important an advance in construction technique been available to the electronics industry. Significant reductions in size, ease of packaging and improved efficiencies lead the list of reasons why toroids have emerged as the currently favorite tool of electronic designers.

Advantages of toroids

The most significant feature of the toroidal coil is that its magnetic flux is almost entirely contained within the coil itself. This means that generous spacing

of the coil from adjacent components, panels and chassis need not be provided. Further, by virtue of using a powdered iron core within the coil, an adequate inductance can be achieved with fewer turns, smaller diameters and resultant smaller physical sizes. When fewer turns are used for the coil, larger gauge wire can be accommodated. Also, if the flux is restricted within the coil, greater Q and improved power transfer efficiency are achieved. These factors add to accomplish less heating loss within the tank coil assembly itself, resulting in more power output.

In rf tank circuits for example, we are able to achieve a volumetric size reduction of better than 8 to 1. Part of this is due to the fewer turns and smaller diameter winding which is possible. More importantly, however, less spacing is required around the coil to accomodate its magnetic flux, because this flux for the most part is contained within the toroid. Therefore, a favorably high Q is achieved without spacing the coil at least one diameter away from the chassis as would normally be required with conventional construction. While promise many desirable features, several new design considerations must be recognized. The higher Q presented by a toroidal coil makes its tuning relatively sharp. This is particularly true when tuning an unloaded or lightly loaded tank circuit. There-

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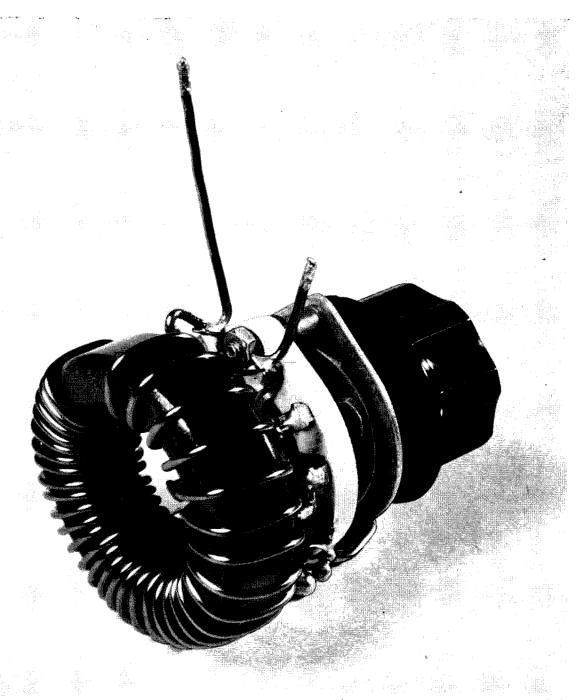


Fig. 1. Toroidal rf tank coil for use in a 100 watt transmitter. The powdered iron core provides High-Q and therefore, good energy transfer. Compact construction results in a tank coil only a fraction of the size normally encountered in conventional designs. The core is given several coats of epoxy cement prior to winding so as to prevent flash-over from the winding to the core. fore, when a toroid is used in a transmitter final tank circuit, it may be necessary to "re-dip" the final more often than a conventional circuit when changing from one operating frequency to another. Also, when the quasi-conductive powdered iron core is placed within a high power rf tank coil, some tendency toward flash-over to the core is experienced. However, with proper precautions

and adequate spacing as described later, this tendency can be eliminated.

The toroidal core

Cores for the toroidal tank coils described in this article were obtained from Ami-Tron Associates, 12033 Otsego Street, North Hollywood, California. Their model T-200-2 was selected for its large size (2 inch out-

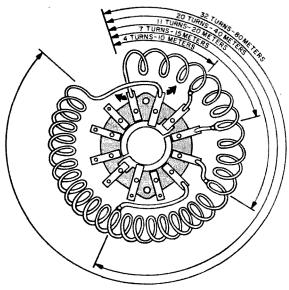


Fig. 2. Winding data is given here for the 100 watt coil. Enameled copper wire (#14 AWG) is used. Windings have a greater spacing at higher frequencies in a manner typical of multi-band tank coils.

side diameter) and 2 kW PEP rating from 500 kHz thru 30 MHz. This same core is used in the Ami-Tron Signal Antenna Balun Kit.

Powdered iron cores are manufactured from iron ore by a process called "sintering". While several special proprietary processes enter into their fabrication by different manufacturers, the essential process requires a thorough dehydration by baking and pulverizing of the iron ore. The resultant iron granules are then compacted or sintered in a properly shaped mold under extreme pressure and high temperature. Organic binders are generally not used. Rather, a mechanical inter-granular adhesion is achieved which produces a solid mass with each iron granule being electrically quasi-insulated from the rest. This is needed, as we know, to prevent hysterisis losses and is analogous to the

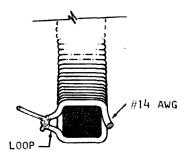


Fig. 3. Taps for connecting to the band change switch are made to small "U" shaped loops in the wire. These loops are placed on the edge of the coil facing the switch and leads are only about 1/2 inch long. The switch is a Mallory ceramic wafer switch.

insulated laminations in a conventional power transformer or choke coil. Higher frequency applications require smaller granule sizes.

The 100 Watt toroid

In our experimentation with toroids in rf tank circuits, three different sizes were selected to satisfy three different power ranges; 100 watts, 500 watts and 1000 watts. The builder might well use somewhat higher or lower powers in connection with the physical sizes of the coils illustrated here.

Corona flash-over to the iron core mass is eliminated by first coating the T-200-2 toroid core with several coats of epoxy cement. Teflon, vinyl or fiberglass tape may also be used for this purpose. Fig. 2 gives the winding data and shows the placement of taps which are connected to a ceramic wafer band change switch. Number 14 AWG enameled copper wire is used. The windings for the 10, 15 and 20 meter portions of the coil are spaced out at the center of the toroid equal to the wire diameter. The remaining 40 and 80 meter portions of the coil are close spaced at the toroid center.

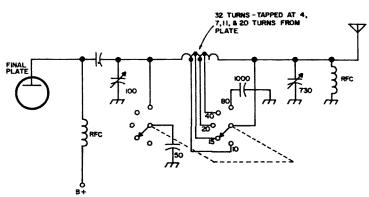


Fig. 4. Schematic of a typical pinetwork. Additional fixed capacitance is provided at both the input and output in the 80 meter position. This permits smaller tuning capacitors to be used.

Taps to the toroid tank coil are made by forming a small loop in the winding as shown in the cross-section, Fig. 3. Stout needle-nose pliers are used for this purpose. After all windings are completed, the enamel is scraped from the loop and short sections of the #14 buss wire are soldered on, completing the connections to the band change switch. These short sections provide a rigid mounting of the coil to the switch and permit the completed assembly to be panel mounted.

The reader will note that a double pole wafer switch was selected for the 100 watt toroid tank coil. This permits the switching in of a fixed 50 pF padder capacitor on the 80 meter band as shown in Fig. 4. Consequently, the smaller 100 pF variable tank capacitor can be used, resulting in further space and cost savings. In the 80 meter position, a switch tap is also available for padding the output or antenna loading capacitor.

Winding toroids

When winding toroids commercially, specialized machines are used. Large numbers of turns are made by passing a bobbin of wire thru the toroid on a circular guide ring. Winding rf tank coils with heavy gauge wire presents a whole new family of problems. The toroids in this article were all wound by hand with a pre-determined length of wire.

The builder's first inclination is to hold the core in a bench vise and pull the turns taut with pliers as shown in Fig. 5. Don't do it! A broken core is bound to result. The core should be held by hand and each turn is pressed into place. While this is a challenge to the strength and endurance of one's fingers, it is necessary for successful toroid construction. Powdered iron cores are fragile and if one happens to be dropped or otherwise broken, it can be cemented together again as shown in Fig. 6. Remember, that insulation between the iron granules of the core is fundamental to its design. Avoid use of organic cements which deteriorate with heat or age.

The following are a few pointers which will ease the task of designing and winding toroids employing heavy gauge wire:

1. If the proper number of turns is not known, wind the coil first with small size bare wire. It will be easier to wind, easier to space out the turns and more con-

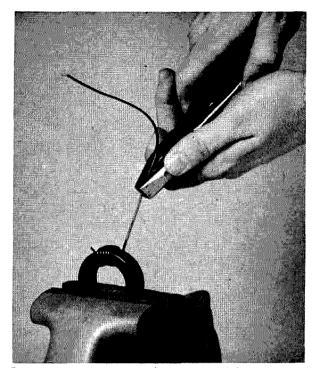


Fig. 5. How not to wind your toroidal coils! The fragile core is sure to break if heavy wire is pulled taut with pliers. When winding toroids, the core should be hand held, and the wire pressed into place with your thumb.

venient to solder on taps to verify where they should be placed. After making the necessary electrical measurements, the small wire can be clipped loose, discarded and replaced with wire of the proper size.

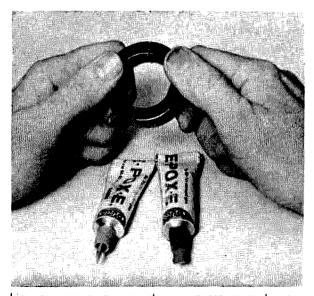


Fig. o. Droken powdered from cores may be repaired with epoxy or household cement. Core material is a quasi-insulator and electrical contact between the broken pieces is neither required nor desired.

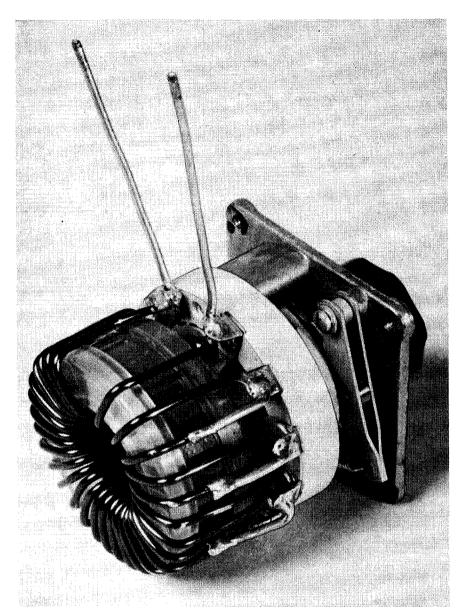


Fig. 7. Medium power (500 watt) toroidal tank coil employs one powdered iron core. The polystyrene endspacers prevent flashover from the winding to the core. Coil taps for the various amateur bands are made to the outside of the windings that bridge across the two end spacers.

- 2. The length of heavy gauge wire required should first be calculated or simulated with string. This will avoid the inconvenience of threading an excessive length of wire through the toroid and will eliminate wastage when cutting off the surplus after the proper number of turns are reached.
- 3. Note the direction to which the windings advance; left to right. Determine the proper winding direction so that taps for the various bands proceed from left to right when viewing the band switch from the front panel.
- 4. Prior to starting the winding, straighten the wire and remove kinks. This can be done by holding one end in a bench vise and jerking the far end with a pair of pliers. Alternately, the far end can be

- twisted an equal number of turns to the right and then to the left with a hand drill. Avoid excessive working of the copper which causes it to harden and become more difficult to handle.
- 5. Start winding from the center of the measured length of wire and work toward each end. This eliminates passing the total length of wire through the toroid core on each turn. It also minimizes work-hardening of the wire and kinking due to excessive handling.
- 6. Press wire firmly in place on each quarter-turn so that tight windings and neat right angles are obtained on each turn.
- 7. Prior to passing the free end of the

wire thru the core, unwind the last quarter turn slightly. This permits the wire to thread through parallel to the axis of the core and avoids kinks.

8. When spaced turns are called for, first wind them close spaced. After the proper number of turns are in place, space them out to the desired locations. This results in neater windings and tends to tighten them upon the core.

500 watt toroid coil

Fig. 7 shows the 500 watt toroid. An Ami-Tron T-200-2 core is also used with this coil. The band change switch pictured with the coil is the husky tap switch taken from a surplus BC-375 antenna tuning unit. These are still available for little cost from surplus dealers who advertise in this magazine. If a new switch is to be purchased for this purpose, the Ohmite power tap switch model 111 or 212 will work very well.

The reader will observe that insulating end spacers have been employed to hold the wire away from the powdered iron core material. About one-eighth inch of space is thus provided and has served well to prevent flash-over from the coil to the core. This spacing is about equal to that usually used between the rotor and stator of a tank capacitor selected for this power level.

Enameled copper wire of #12 AWG size is used for the 500 watt toroid coil. It is wound using the same general instructions as used with the 100 watt unit. Because a larger coil diameter results from use of the end spacers, fewer turns can be employed. This is a welcome advantage due to the smaller inner diameter of the end spacers and less space which is available for the windings. Fig. 8 gives the winding data and tap information for the amateur bands from 80 to 10 meters inclusive.

1000 watt coil

Fig. 9 illustrates the high power coil which is suitable for 2 kW PEP on single sideband. The 10 meter portion of the coil has been externally wound. This was done to provide further isolation of the high impedance or highest voltage end of the coil from the powdered iron core. Copper tubing of 3/16 inch diameter is used for the 10 meter coil and #10 AWG tinned copper buss wire is used for the remainder of the coil within the toroid core.

In the 1000 watt coil, two Ami-Tron T-200-2 toroid cores are used to minimize the possibility of core saturation and "flat-topping". Prior to winding, the two cores as well as the end spacers are cemented together with epoxy cement. This makes winding of the coil much easier. Alternately, the two cores and two end spacers could be temporarily clamped together or lashed with string until the initial windings are in place.

The heavy duty band change switch is again used as previously described. Even with the greater mass presented by the two cores and heavier wire, no problem was encountered in making the complete assembly rigidly panel mounted by short pieces of #10 AWG copper buss connecting the taps to the band change switch. Fig. 10 provides the winding data for the high powdered coil. This spacing is ensured by placing small ¼ inch by 2 inch pieces of 1/16 inch aluminum or plastic between the turns at the center of the coil. After proper and uniform spacing is achieved the individual turns are secured to the end spacers with epoxy cement. The temporary spacers can then be removed.

End spacers

Polystyrene sheet % inch thick is used to

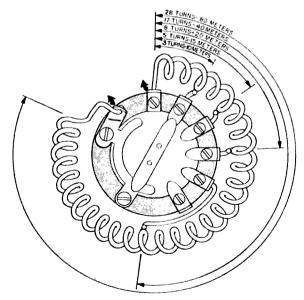


Fig. 8. The medium power toroid tank coil uses a surplus switch from a BC-375 Antenna Tuner. Windings are made with #12 AWG enameled wire. Fewer turns are required when the end spacers are used due to their producing a larger effective coil diameter. The 10 and 15 meter windings are spread out slightly more than the rest of the coil.

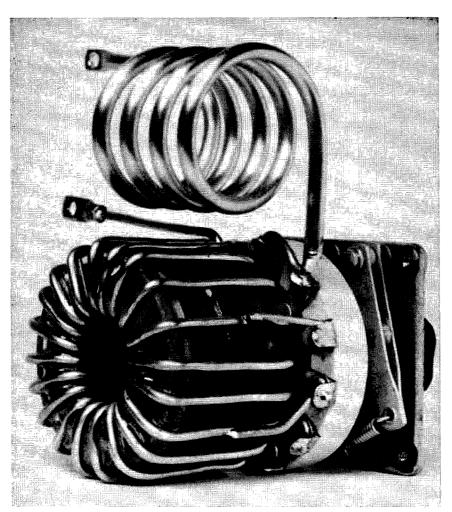


Fig. 9. High power tank coil for 1 kW operation. Two cores are stacked to lessen the possibility of core saturation. Larger wire (#10 AWG) is used in this model. The same heavy duty band change switch is used for this and the medium power version.

make the end spacers. Fig. 11 gives the dimensions of these pieces. Lucite or bakelite should not be used due to their inferior dielectric strength. The end spacers can be readily make on a lathe or can be cut out and recessed by means of a chassis fly-cutter in a drill press. If the end spacers are to be cemented to the toroid core, it is not necessary to cut the circular recess in them as pictured.

Tap connections

Fig. 12 shows alternate methods of securing tap connections to the toroid coils. Good success was achieved by providing about a ½ inch overlap of the tap lead on the coil winding. Solder is cautiously flowed on both sides of the tap taking care not to melt the polystyrene end spacer material. When assembling the coil to the band change switch, it is desirable to first form and solder the two major coil ends to their proper terminals on the switch. This serves to position the coil and makes it more convenient to form the taps and solder them in place.

Coil measurements

A Boonton Q Meter is invaluable in the empherical design of coils. However, such an instrument is not generally available to the amateur constructor. In lieu thereof, a grid-dip meter and calibrated capacitor will serve for frequency determination. A recent article in 73 Magazine⁷ described this method. The three toroid tank coils were measured on a Boonton Q-meter and the following unloaded Q values were recorded:

Band	100 watt	500 watt	1000 watt
80	310	360	332
40	177	200	190
20	160	205	188
15	132	186	190
10	128	146	250

The lower Q values measured at the higher frequency bands are due to the coil being "bunched-up". That is, the small number of turns occupy only a fraction of the total core length. To achieve maximum Q for any given number of turns, those turns should be spaced out evenly over the whole core

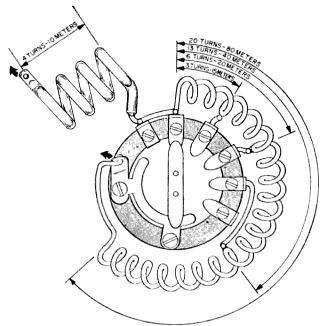


Fig. 10. The high power coil utilizes two powdered iron cores whose larger winding cross section requires that still fewer turns be used than for the medium power coil. While it is optional with the builder, in this case, the 10 meter section of the tank was externally air-wound. This is desirable because it reduces the electro-potential stress between the "hot" end of the coil and the core. Four turns of 3/16ths inch diameter copper tubing are wound on a 1/4 inch diameter form and spaced out to 13/4 inches long.

length (or circumference). This situation is always encountered with a multi-tapped coil. It is interesting to note that the high power 10 meter coil has a relatively high Q. This is obviously due to its heavy construction, optimum length/diameter ratio and the fact that it is self-supporting, external to the toroid.

Fig. 13 provides a handy guide in determining the value of tank capacitance to be used in resonating these coils. Of course, the first step to be taken when designing a resonant tank circuit for your transmitter is to select the proper L/C ratio to match the tubes output impedance. The toroid coils described in this article are suitable for most tubes in common use today. However, if several amplifier final tubes are paralleled as is frequently done, the reader should be guided by the references on this subject in one of the amateur radio handbooks to obtain a proper L/C ratio.

The future of toroids

Having already gained wide spread use in

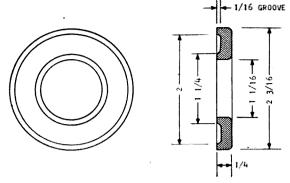


Fig. 11. Drawing showing dimensions of end-spacers used on both the medium and high power toroidal tank coils. Polystyrene, 1/4 inch thick is used to make the end-spacers by means of a chassis fly-cutter mounted in a drill press. Wire tension and friction hold the end-spacers in place.

many lower power applications, toroids can now be used to great advantage in high power transmitters. Perhaps before long, commercial transmitters will be using toroids. In the meantime, the amateur may avail himself of their superior compactness and efficiency and thereby continue the pioneering heritage which has earned the amateur radio operator and constructor his place of respect today.

Acknowledgement

Mr. Joe Williams, W6SFM, of Ami-Tron Associates was most helpful in furnishing toroid core material, technical advice and encouragement in developing the coils described here. To Mr. Paul Sellers, W4EKO, goes thanks for early design criteria and the pioneering approach to high power toroid rf coils. The assistance of Mr. Frank Emens. W4HFU, was invaluable in making coil measurements, and Mr. Jim Bauman and

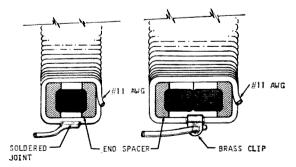


Fig. 12. Details of alternate methods for making the tap connections to the toroidal tank coils. Care must be taken to prevent solder from bridging over to the core, thus promoting a flash-over. Excessive heat must be avoided when soldering near the end-spacers so as to prevent their being melted.

AMI-TRON

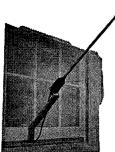
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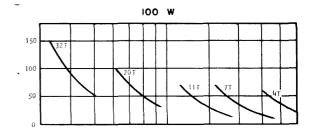
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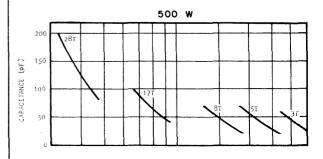
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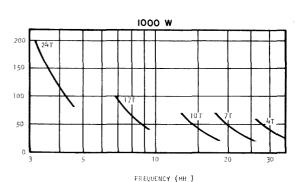


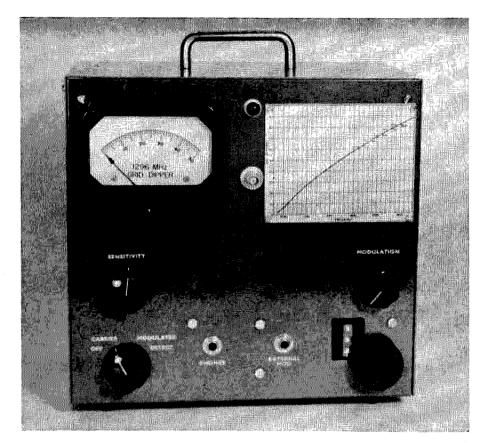
Fig. 13. Charts showing the capacitance required to resonate the three toroid tank coils on the five amateur bands. The L/C ratios obtained on each band match the tube impedances most frequently used today. If a very low tube output impedance is encountered, such as found in paralleling of many TV tubes, a much lower L/C ratio would be called for.

Mr. Jack Hood of RCA, Huntsville, Alabama deserve credit respectively for the model shop work and art work used in this article.

. . W4BRS

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Jim Fisk WIDTY RFD I Box 138 Rindge, N.H. 03461

A 1296 Grid Dipper

Conversion of the APX-6 transponder to a grid-dip oscillator that covers from 1050 to 1320 MHz.

One of the big problems with operating on 1296 MHz is locating the operating frequency of your equipment. Not only is the newcomer faced with this problem—any longtime resident on 1296 will attest to the many checks he has made to ascertain operating frequency and band edges. Some UHF amateurs have been able to obtain signal generators that cover the 1215 to 1300 MHz band, but many must resort to the time-proven lecher-wire system for any meaningful frequency measurements on this band.

Each of the systems commonly in use suf-

fer from one disadvantage or another. Moreover, there is no commercial grid dip meter on the market, to my knowledge, which will cover this range. Most of them stop at 1000 MHz or so. This conversion of the APX-6 is not difficult and results in a very versatile grid-dip meter. Like its lower frequency counterparts, it may be used for dipping resonant circuits, detecting rf energy or as a signal source. The built-in Veeder-Root counter provides excellent frequency readout and the internal gear system ensures repeatability.

The only part of the APX-6 you need for

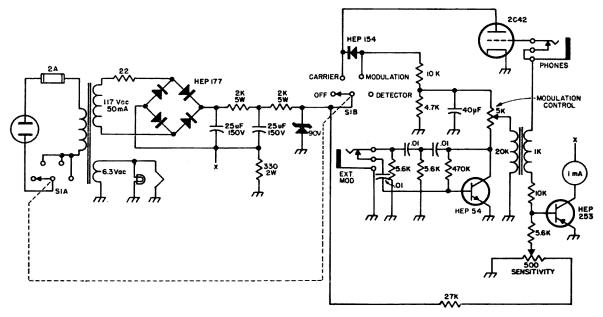


Fig. 1. Schematic diagram of the APX-6 grid-dip oscillator. Note that a 2C42 is used in the oscillator instead of the original 2C46. The built-in bypass capacitors and cavity inductance are not shown in this drawing.

this conversion is the cavity assembly. You can buy the door assembly of the APX-6 from many surplus dealers, but this contains the if strip which you don't need. In any case, the cavity assembly, with or without the if strip can usually be obtained for less than ten dollars. I picked mine up at an auction for five bucks-the original owner had started to convert it but evidently had given up. No matter, the transmitter and T-R cavity don't serve any useful purpose in this conversion. In fact, if you can obtain an APX-6 that has already been converted for use on 1215 MHz, by all means do so. Many times units that have already been converted go for much less. The only requirement for this that the conversion is receiver local oscillator cavity has not been disturbed. This is the case in most of the popular conversions.

The first step in this conversion is to pull out the tubes and separate the cavity assembly from the door. Now remove the screws holding the cathode cavity plate to the cavity body and the six screws holding the cavity body to the gear and counter housing. To remove the cavity body, pull it straight up from the casting. With the unit broken down to its three main parts, we can start the

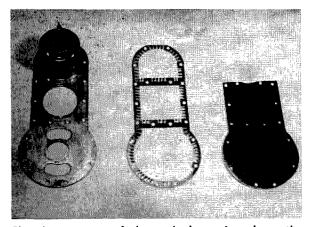
actual conversion process.

First of all, pull the plate off the back of the gear housing. Inside you will find three sets of bevel gears and the rest of the paraphenalia that translate cavity plunger move-

ment into numbers on the counters. Turn one of the counters up to 999 or down to 000. Note the tab on the horizontal gear which engages with the tab on the small bevel gear to prevent further movement of the tuning plunger. As you look at the casting from the rear, the receiver cavity is on the left, the diplexer (transmit-receive) cavity is in the center and the transmitting cavity is on the right.

Remove the five screws which hold the bottom plate on the housing and carefully remove it from the casting. It has to be pulled straight out. Three long pins with small locating tabs at the top are mounted on this plate. These tabs fit into keyways located in the tuning plungers. The receiver and diplexer plungers are removed by pulling them out from the gear end; the transmitter plunger is lifted from the top after unscrewing it from its drive gear. Now remove and discard the transmitter and diplexer Veeder-Root counters and gear trains. To remove the ¼ inch drive shafts (on which the knobs were mounted), drive out the small retaining pins with a pin punch.

Unscrew the receiver tuning plunger from the gear assembly and cut % inch off the end. This can be done on a lathe by any machinist or, with care and a very fine hacksaw, at home. To prevent undesired resonances the cut must be exactly perpendicular to the plunger axis-this is best accom-



The three pieces of the cathode cavity plate—the modified plate to the left, the serrated contact ring in the center and the new plate cover on the right.

plished on a lathe. Handle the plunger very carefully so the surface is not scratched. If it is damaged, the diplexer plunger may be used as a substitute.

While the plungers and gears are out of the housing, remove the shoulders around the transmitter and diplexer drive shafts on the front of the casting. If these shoulders are not cut off with a hack saw or filed down, the completed unit won't sit flush against the new front panel.

After the piece is cut off the tuning plunger, screw it on the gear drive assembly and push it through the contact fingers on top of the gear housing. Set the Veeder-Root counter to 000 and put the bottom cover in place. Now you have to do a little juggling. Adjust the plunger so it just protrudes through the contact fingers. Now mesh the drive gears so that the *stop* tabs engage. Usually you'll have to move the gears a few teeth each way to get the shaft to stop with the counter on 000. When the gears are all lined up, install the screws in the bottom cover.

The first step in the conversion of the cavity body is to remove the large coaxial connector. Remove the screw from the split collar which holds the connector on the front of the cavity. When the screw is removed you should be able to rotate the connector in the collar. The center contact is soldered to a pickup loop which is located in the wall between the diplexer and transmitter cavities. When this joint is unsoldered the connector may be easily removed. Remove the collar by unsoldering it from the front of the cavity.

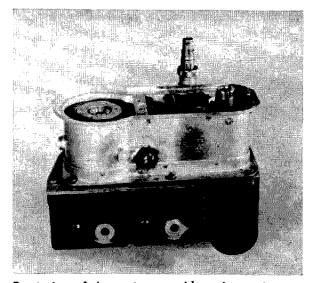
Cut out a piece of copper 1-23/32 inches wide by 2-1/4 inches long. This will be used

as a partition in the center of the old diplexer cavity. If you cut this partition a little larger than required and form lips at the edges, it may be force-fit into the diplexer cavity and no soldering is required.

Look down inside the receiver cavity. You will note that the plate voltage is applied through a feedtthrough capacitor (C403) to a piece of wire which winds spirally around the plate line. Unsolder this wire from the capacitor, remove the three retaining screws and pull out the plate line. This line must be shortened by ½ of an inch. This is most easily accomplished with a tubing cutter.

In the unmodified APX-6 the local oscillator energy from the receiver cavity is coupled into the crystal mixer with the small loop adjacent to the aperture in the cavity wall. Somewhat heavier coupling must be provided for grid dip service. Cut a strip of copper ¼ inch wide and about 2½ inches long. Form a short tab on one end of this strip and solder it to the bottom of the receiver cavity about ¼ inch out from the wall. Put a "Z" bend in it as shown in Fig. 2. and solder it to the contact on the crystal mixer. After the new coupling loop is in place, put the modified plate line back in place and reconnect the B plus line to the feedthrough capacitor.

Unscrew the connector from the crystal mixer and pull out the diode. Remove the crystal retaining fingers from the BNC connector with a pair of pliers and push an awl through the ceramic capacitor which is built into the connector. Remove the pieces of ceramic and pull out the center contact.



Front view of the cavity assembly and gear housing before installation of the cathode cavity plate.

Save this female pin. If the ceramic capacitor is not removed, all of the 1200 MHz oscillator

energy will be bypassed to ground.

If you look closely at the back end of the mixer assembly you will see a round cover plate which is soldered in place. You will also see that a small hole has been drilled through this plate. Form a small hook in the end of a piece of #16 buss wire and hook it through this hole. Heat the cover plate with a small torch and when the solder is softened, pull the plate free with the buss wire. Solder a two inch length of #18 wire to the center contact of the mixer assembly and run it up through the connector body-cut it so it extends 13/16" above the threaded shoulder. Solder the female connector pin to the end of this wire and replace the BNC connector. Replace the round cover plate on the rear of the old mixer assembly and solder it in place. Modifications to the cavity body are now complete.

Unsolder the diplexer cavity from the cathode cavity plate and discard it. Discard the transmitter cathode cavity and saw off the grid contact fingers which extend above the plate at the transmitter end. Using the cathode cavity plate as a guide, cut out a piece of thin aluminum as shown in the photographs to cover up the holes. This cover serves no functional purpose, but it does make a neater looking unit. All that is left are the modifications to the receiver cathode cav-

If you look inside the receiver cathode cavity, you will see that the grid contact is suspended from the top of the cathode cavity with three wires. These wires are soldered to both the cathode cavity and the grid ring. Carefully unsolder the support wires from the top of the cavity and pull out the grid ring; remove the three wires. Enlarge the three holes in the top of the cavity with a reamer, install three 500 pF feedthrough capacitors (Erie X5UO 501M or equivalent), and solder them in place. These feedthroughs consist of a coaxial shell and are actually only half a capacitor-when you run a wire through the center, the capacitor is formed. If you can't locate this type of capacitor, you can make your own by unsoldering and removing the center conductor from a conventional feedthrough capacitor.

Solder three 1½" lengths of #16 buss wire to the grid ring and put it back in the cathode cavity with the new support wires going through the feedthrough capacitors.

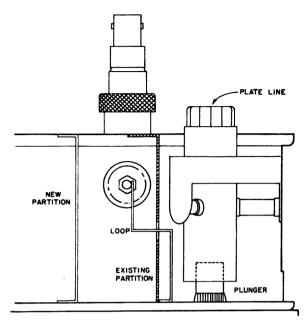
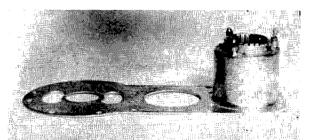


Fig. 2. Cutaway view of the APX-6 receiver cavity showing the location of the new pickup loop.

Place the 2C46 in the cathode cavity and use it as a guage for placing the grid ring in the proper position. When you have everything all lined up, solder the three supporting wires to the feedthrough capacitors. It's a good idea to check for shorts between the grid ring and the cathode cavity before soldering everything down—they should be electrically isolated for dc.

The APX-6 cavity modifications are now complete. It will tune smoothly from about 1050 MHz to well over 1300 MHz and grid current may be monitored in the modified cavity. All that is left is the power supply and modulator.

For maximum stability the power supply is regulated with a zener diode. The ninety volt supply is more than adequate for this purpose—when the grid is shorted to ground the grid current is nearly 1 mA. With the 10,000 ohm grid resistor, grid current is on the order of 150 A. A 200 microampere meter



Closeup view of the modified APX-6 local oscillator cavity showing the installation of the grid-ring feed-through capacitors.

ity.

is ideal for this grid dipper, but since I had a large 1.5 mA meter which I wanted to use, I incorporated a simple transistor meter amplifier. The negative supply voltage for the amplifier is developed across the 330 ohm resistor in the power supply. The meter amplifier transistor and bias resistors are mounted on a small piece of Vector board which is mounted on the meter terminals. If you don't want to use the meter amplifier, simply connect the meter between the arm of the sensitivity control and ground.

Modulation of the oscillator is provided by the 1000 Hz transistor phase-shift oscillator—modulation is adjustable up to about 90%. The oscillator is constructed on a small piece of Vector board which is mounted behind the APX-6 cavity on the main chassis. A jack on the front panel may be used for external modulation—a three to four volt audio signal will provide 90% modulation.

I built the chassis for my APX-6 grid-dipper from sheet aluminum, but a standard 12" x 11" x 8" utility cabinet can be used if you don't like to bend aluminum. My chassis is 11" wide, 10½" high and 5½" deep and consists of two U-shaped pieces. Bracing is provided by two brackets across the top and bottom as shown in the photographs. These brackets are made up from do-it-yourself aluminum angle and actually

serve two purposes. In addition to strengthening the chassis, three tapped holes in each bracket accept the cover retaining screws. The front panel is laid out as shown in Fig. 3. Even if you don't use this type of chassis construction, it is recommended that you use this panel layout.

The parts placement was chosen to provide a balanced layout. This means that all the available space is used. In fact, the two phone jacks occupy space previously taken up by the discarded counters in the gear housing. If they are moved to any great extent, they will interfere with the gear housing. The layout for the square counter cutout and five cavity mounting holes are not shown in Fig. 3—these are best obtained by using the old APX-6 door as a template.

Construction is quite straightforward and no problems should be encountered. Note, however, that the phone jack in the grid lead must be isolated from ground—this is easily done with fiber washers. Since the jacks are hidden by the gear housing when the cavity is attached to the front panel, wiring to them is run through the small screw holes drilled in the bottom of the housing. These holes were originally used to hold the counters in place.

The output of the oscillator is connected to the front panel connector with a short

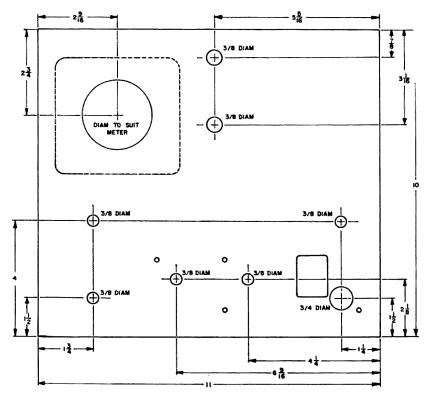
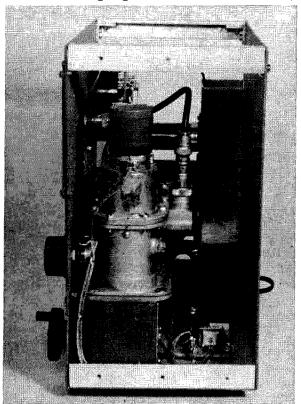


Fig. 3. Front panel layout for the APX-6 grid dipper. The locations of the square counter cutout and cavity mounting holes are not shown—they are best determined by using the old APX-6 door as a template.

length of coaxial cable. One of the newer Teflon insulated cables would be ideal for this purpose, but RG-58/U is perfectly adequate—that's what I used. Mismatch losses at the BNC connectors may be minimized by using the connector assembly diagrams in 73°.

Although a 2C46 was used in this cavity in the original APX-6, I found that it would not *always* oscillate in the modified cavity when power was applied. Substitution of the 2C42 from the old transmitter cavity solved this problem. An added bonus was the extra power output available with the 2C42.

Since there is a considerable difference in grid current between the oscillator and detector modes, be sure to turn down the sensitivity control before switching from one mode to another. If you don't, the needle will slam against the pin. It's also a good idea to turn the modulation control down when modulation isn't required. Since the meter indicates the relative magnitude of the modulating signal, less meter sensitivity



Inside the APX-6 grid dipper. The phase-shift modulator is in the right foreground, the power supply chassis is mounted on the rear panel. The cover is held with screws through the tapped holes in each of the four corner braces.

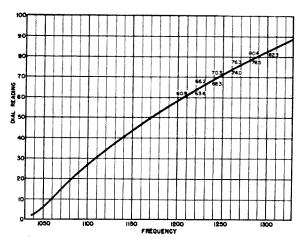


Fig. 4. Calibration curve of the APX-6 grid dipper. Counter readings for each 10 MHz point in the 1215 MHz band are included for accurate interpolation.

is required when the oscillator is modulated. If the modulation is turned up when you switch from carrier to detector through the modulated position, a bent meter pin is inevitable.

After you have completed the unit, all that is left is calibration. There are several approaches at this point, depending upon the type of equipment you have or can borrow. Lecher wires are the most straight forward but not necessarily the easiest. I used a General Radio 1140A wavemeter and an old surplus echo box and then made a double check with an LAE signal generator which covers this range. The calibration curve (Fig. 4) was then mounted on the front of the grid dipper for easy reference.

The completed unit tunes very smoothly through its range with no jumps in frequency. A few false dips in grid current appear around 1100 MHz, but in the main range of interest, 1200 to 1300 MHz, there are no false dips. In the detector mode, rf signals down to several millivolts provide an upswing on the meter. When used as an oscillating detector with headphones, significantly lower magnitude energy may be readily detected.

For the amateur who is interested in operating on the 1296 band, this grid dipper is a very useful piece of equipment. It may be used for tuning up converters, dipping out filters, detecting parasitics, determining transmitter frequencies and in tuning up frequency multipliers. In a pinch it may even be used as a low power transmitter by plugging in an external modulator.

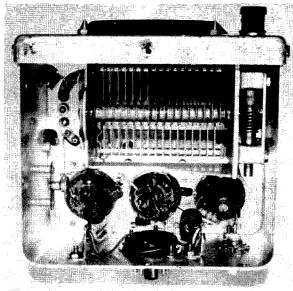
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^{*&}quot;Coaxial Connector Handbook", WA6BSO, 73, August 1966.

Using FET's in the Command Set Transmitter

How to build a very stable VFO using a Command Set and three transistors—one FET and two conventional types.

Do you need a good stable VFO that's quite easy and inexpensive to build? Well I did, and after discarding many possibilities I came back to the old reliable Command



Bottom view of the transistorized Command Set. The oscillator section of the original Command Set is located on the rear of the chassis. In this conversion the chassis was cut in half and the rear part attached to the front panel.

Set. Tubes were definitely out—after all, who needs them with so many types of semi-conductors to choose from. Besides, the FET is supposed to behave like a tube, why not use it.

Hastily I attached an FET to the cathode, grid and plate pin of the oscillator tube. Boy, was I surprised—the oscillator took right off when voltage was applied without any component changes.

Enthusiastically, I began to remove everything from the chassis and decided to cut down its size as detailed in the Command Set* book. All parts except those associated with the oscillator were removed. The set was then rewired as shown in Fig. 1. The first transistor after the FET oscillator is operated as a class A buffer amplifier to isolate the oscillator from the output transistor and to build up the small signal to drive the next stage. The output stage is a broadband class C amplifier and only draws current when the oscillator is operating. No tuned circuits are used except the original circuit so the output is constant across

*"Command Sets," Copyright 1957 by Cowan Publishing Co., Port Washington, L. I., N. Y.

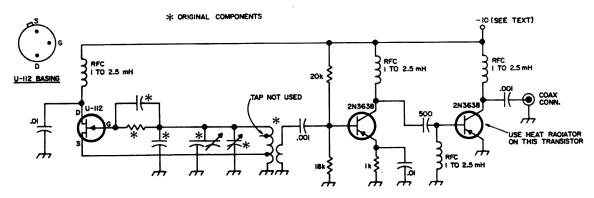


Fig. 1. Schematic of the transistorized Command Set transmitter. All components marked with an asterisk are original Command Set parts. The use of an FET in the oscillator circuit permits a simple and direct conversion from vacuum tube circuitry to semiconductors.

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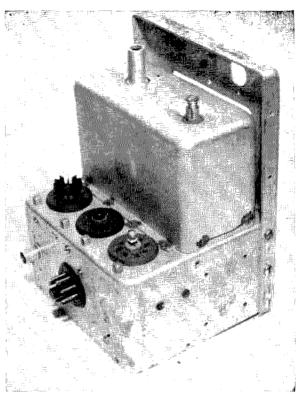
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The shortie, transistorized Command Set. The transistor sockets are mounted in the center of the old octal tube sockets.

the band. With a 10 volt supply you get a full watt of input power to the final transistor. This is plenty enough to drive any crystal controlled transmitter.

All the HF Command sets were tried and the oscillator functioned perfectly. I won't attempt to give any of the basic data on converting the Command Sets. This information is quite readily available and would only bore most readers.

To keep the heat dissipation of the final transistor within safe limits, 10 volts is used for the supply voltage. Even with 10 volts a cap type heat radiator should be used. An increase of 2 volts more than doubles the power so be careful. When driving a Gonset Communicater III, for which this unit was designed, I find that dropping the supply voltage to 6 volts is more than ample to drive the transmitter to full output.

The transistors really carry a nice price tag, and should appeal to almost everybody. They are made by Fairchild Semiconductors and sell for about 62c apiece. The FET is a Siliconix unit. If another type is used it should have a transconductance of 1000 or better. If you really like pleasant surprises try this conversion.

. . . K3LCU

The Dichotomy of a Tube Man

Including the use of a FET in the BC-906 frequency meter.

It is hard to resist a winning combination, particularly when that combination happens to be articles and ads in 73 magazine. The spell-binders referred to are, "Field Effect Transistor Primer" by Jim Fisk¹ and "Two Transistor Testers" by Frank Jones.² Couple these with advertisements such as Poly-Paks and Meshna in which you find almost unbelievable semi-conductor and transistor bargains and you are lost.

When such a powerful coalition causes an old died-in-the-wool tube man to become a transistor enthusiast, that is an accomplishment. Would you believe a fellow who buys two assortments of 50 new, unused, 20-24 year old tubes for \$2.95 per assortment*, just to have them on hand in case? Hold on now, consider what electronic miracles you might perform with an orbital beam, hexode uhf amplifier, type 1630, Army Signal Corps Tube VT-128! Just to hold it in your hand and look at it is inspiring. It looks like a grown-up 955 acorn tube, except that it has 12 radial electrode wires instead of five. Into this world of dreams came WHAM, POW, SOT-Fisk and Jones et al.

After the order of solid state goodies arrive, you find yourself impressed by how few identifying marks are on the TO-5 and other style cases. In fact, you reminisce and recall that at least you could peek inside * 1964 Catalog, McGee Radio Company, Kansas City, Missouri.

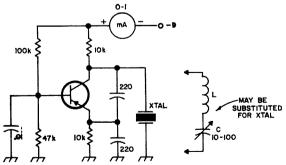


Fig. 1. Circuit for testing the oscillating characteristics of unmarked transistors. This circuit is shown with a negative supply for PNP transistors—for NPN units reverse the meter and use a positive supply.

the orbital beam hexode glass envelope and try to guess which is the grid, filament and cathode lead. At this point enter Frank Iones. Build up and use one of his transistor testers and the door of knowledge is opened. No longer do you care if you can't see inside. Everything becomes orderly. PNP's go into one box and NPN's into the other. The duds are set aside for Psuedo-Zener use. The sorting process turns into an exhilarating game. Plug them in, test, pull 'em out. You don't mind that after squeezing the three little wires between thumb and forefinger for the hundredth time, you have an excruciating cramp in the thumb! But wait; now that these wonderous things are sorted, how do you know which of them is "Power", "RF", "IF", "Audio", "Switching" and no test? Frantic thumbing through all issues of 73 from January 1962 forward was of little help for a solution to this new dilemma. In fact it was a hinderance. You find far too many tube articles which you remember wanting to try! Anyway, after having invested so heavily-at least \$10 so you can take advantage of the double bonus-it is incumbent upon you to take the next step to find out which of these little three-pronged rascals will oscillate. A circuit to help sort the unmarked transistors further is shown in Fig. 1.3

This is a Clapp transistor oscillator, either crystal or series L-C resonated. As shown, the battery and meter are set up for PNP's. Change the polarity to check NPN's, By using several crystals, for example, 450kHz, 2MHz, 3.5MHz and 7MHz or higher, you can learn which of the 100 or more bargain transistors in your possession will oscillate. It sure takes a lot of plugging but it's worth it. Imagine the thrill that shivers through your frame as you hear that crystal clear note in the station receiver. It takes you back to the days when-for old-timersafter you sawed two hacksaw slots at right angles across the bakelite base of a type 76 triode, between the four prongs, so as to decrease the dielectric shunting, you got the

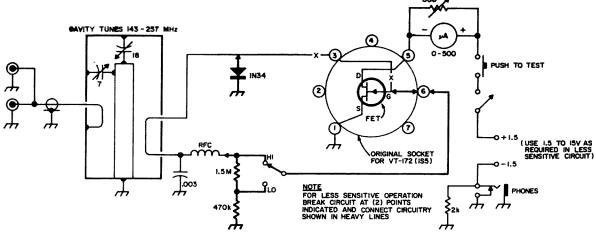


Fig. 2. Conversion of the BC-906 frequency meter to a field effect transistor. This frequency meter will detect rf signals down to a 100 microvolts or so and will tune through both the 2 and $1\frac{1}{4}$ meter bands.

tube to work at 2½ meters! For the younger man the occasion might be similar to uncorking his first 807 on 10 meters. At any rate, the yield of good oscillators from the packet of 100 bargain items is surprising. Many were vigorous to 7.3MHz. How well they will work in other circuits remains to be learned. It may be safe to assume that some of them will perform as rf amplifiers; how noisy they are can be learned from trial and error unless one uses the more modern transistor testers which are available at much greater cost than the simple ones referred to in this work.

The field effect transistors are indeed fascinating. It boggles the mind to think what would have happened to the radio-radarsonar systems had the solid state version of the tube arrived first. We'd probably be discovering the vacuum tube about now and that would be a blessing to those of us who need bi-focal glasses in order to work with these miniature components. Jim's FET Primer caused me to try the FET's offered by Poly-Paks. Again, the ones received are unmarked except that one is painted an ominous black. The advertisement seems to say that mine are low noise FET's made by Crystalonics. The package has a nice re-print from 73 and also some data which leads me to believe that one of the FET's is a C-610. Since my surplus BC-906E Frequency Meter had a 1S5 tube which went west, it was a logical choice to go FET. The original and modified circuits are shown in Fig. 2.

The FET can be plugged into the tube socket for experimentation, then later soldered in if you so desire. The schematics show the tube socket pin numbers in which to plug the FET leads. It is necessary to

remember that when looking at the bottom of the FET, the base lead is where the collector lead normally is located on a standard transistor. (Not on all FET's. Consult manufacturer's data sheet if in doubt. Ed.)

The absorption wave-meter with the FET performs much the same as the original tube version. One less battery is required and the battery voltage will depend upon the FET used. The FET which I assumed to be a C-610 works well with 1.5 volts. When the meter reads 500 micro-amperes full scale, the measured drain current is 1.5 milliamperes. As the cavity is tuned through a two meter rf field, the drain current will dip just as it did with the vacuum tube in the circuit.

The sensitivity may be improved by leaving out the 1N34 diode and disconnecting the 1.5 megohm resistor from the end of the radio frequency choke nearest the Hi-Lo switch. These modifications are indicated in Fig. 2 by the heavy lines. Then, with the rf lead from the cavity connected to the gate of the FET, the field effect transistor will act like an old-fashioned vacuum tube with a floating, leaky grid.

With this modification the frequency meter will respond to 100 microvolt signals fed into the cavity by way of the plug-in antenna. The fact that the FET will perform in this manner is a measure of compensation and a bit of solace to a hard vacuum tube man.

W5SOT

WA6BSO, "Field Effect Transistor Primer," 73, December 1965.

^{2.} W6AJF, "Two Transistor Testers," 73, September 1966.

^{3.} M. S. Kiver, "Transistors," 3rd edition, 1962, McGraw-Hill Book Company, New York.

Del Crowell K6RIL 1674 Morgan Street Mountain View, California

Converting the Swan 120 to 6 Meters

With the continued upswing in sunspot activity, intercontinental DX on 6 meters is just around the corner. This simple and inexpensive conversion will provide a complete SSB transceiver for six.

This conversion makes a complete 180 watt PEP six meter transceiver with more features than the original 20 meter unit and compares favorably with commercial 6 meter units at much less cost.

General description

With the Swan single band transceivers consistently appearing on the used market,



Part of K6RIL's shack. The six meter Swan 120 is in the right foreground. The rack on the left contains a kilowatt and transverter for 432 MHz, a 2 kW PEP rig for six and a 2 kW amplifier and transverter for 144.

the SW 120 models may be purchased for a very reasonable price. This inspired me to investigate the possibility of converting one into a 6 meter transciever. The investigation seemed to prove that this was entirely possible.

I noticed that the Swan people left a lot of chassis room in the right hand side around the final section, so I decided to take a chance. A SW 120 was purchased for \$85.00 and the modification was started. I was quite amazed at how simple the modification appeared. As described previously, there is a lot of empty space under the chassis for adding extra parts.

New transmitter circuit

The transmitter conversion consists mainly of changing the original driver stage to a second conversion mixer and removing the original driver plate coil and all of the final circuits. The new driver, a 6CL6, operating in class A, and new final with 6146's operating in AB1 were added. In addition, a local oscillator with buffer was installed. These added parts fit into the empty space very nicely. When checking out the transmitter, two major problems were encountered. First,

ORIGINAL DRIVER MODIFIED TO MDER

DRIVER TUNE

DRIVER (NEW)

V2

V2

V2

V2

V2

C20

GCL6

A

TO I2BE6

PLATE

DRIVER (NEW)

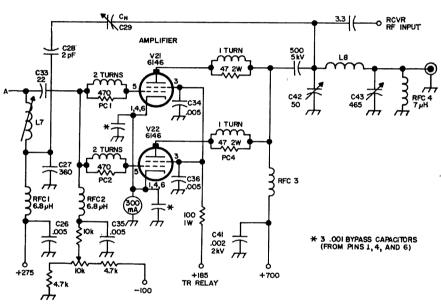
V2

C20

C20

CC20

Fig. 1. New circuit of the SW 120 for six meters. L4 and L5 are 8 turns number 26 on a 3/8" form. Relocate L5 and wire as shown. L6 and L7 are 5 turns number 20 closewound on a 3/8" form—use a white slug. L8 consists of 31/2 turns of 1/4" copper tubing—11/4" inside diameter, 23/8" long. Parasitic chokes PCI and PC2 are 2 turns number 22 wound around a 470 ohm. 1/2 watt resistor. PC3 and PC4 consist of one turn number 14 wound around a 47 ohm, 2 watt resistor. RFC3 is the original choke with 1/4" removed from each end.



the final showed signs of instability even after neutrilizing. This proved to be parasitic oscillations-parasitic chokes in the plate leads cured this problem. The driver was also unstable-the original 11 pF butterfly driver capacitor was used to reduce the cost of modification, but this capacitor produced too much feed back due to the configuration so a new double section capacitor had to be used. Since a small capacitor with low capacity was not available on the market, a small bracket was fabricated and two Johnson type 160-140 capacitors were ganged for this job. This arrangement provides good isolation, takes up a minimum of space and gives more than adequate tuning range.

New local oscillator circuit

A new local oscillator and buffer were installed using a 6EA8. The triode section oper-

ates as a standard crystal oscillator with low voltage applied to the plate and the pentode section provides a small amount of gain and acts as a buffer to prevent frequency shift. A crystal switch and five sockets were installed to give additional coverage in the band. The crystal switch also has additional contacts to resonate the buffer coil when the oscillator frequency is changed—this adjusts the buffer output to maintain a constant injection level.

The crystal switch mounts in the hole where the tune switch was originally mounted; this tune switch was completely removed and the wires disconnected. The 12AV6 that was used as an audio oscillator is converted to an AGC amplifier.

Other transmitter changes

The basic exciter was left as original

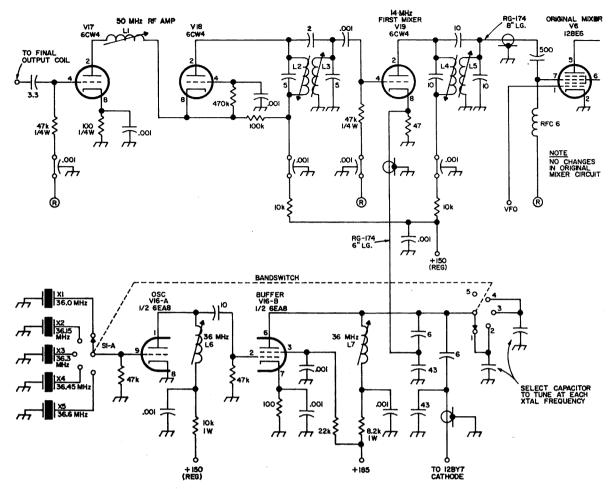


Fig. 2. Conversion of the SW 120 receiver to six meters. L1 consists of 10 turns number 26 closewound on a $\frac{1}{4}$ " slug-tuned form. L2 and L3 are both 12 turns number 26 closewound on a $\frac{1}{2}$ " form; L4 and L5 are 30 turns number 30 closewound on $\frac{1}{4}$ " form; L6 and L7 are 11 turns number 26 closewound on a $\frac{3}{8}$ " slugtuned form.

except for the minor changes shown in the carrier balance control and transmit-receive switch. Also, the VFO was adjusted to cover 14.0 to 14.150 MHz to the 12BY7 mixer. This was only done to use a crystal that was available. The original dial calibration was used with the 20 meter markings removed with a pencil eraser (don't use paint thinner). New markings were made to indicate 0-100 kHz and 150 kHz. When calibrated, the dial now can be read to 1 kHz and crystals can be selected to cover any 150 kHz range in the band.

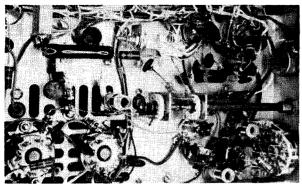
The original driver plate coil with associated capacitors is now installed under the chassis and connected to the grid of the 12BY7 mixer. A 10 pF capacitor is connected between the two coils—this forms a 14 MHz bandpass coupler for added rejection.

Transmitter modification

Before starting the conversion to six, a

preliminary check of the transceiver should be made to insure proper operation on the original band. Disassembly is accomplished by first removing all covers and the front panel. Mark any wires that may be disconnected. Follow these steps for removal of the unused parts:

- 1. Remove the final tube and all parts in the final compartment; leave only the plate and load capacitors and the two stand-off insulators.
- 2. Remove the 6DQ5 socket, disconnect wires and mark each with the pin number as it is removed. Pull the wires back through the chassis, but leave the meter wires in place.
- 3. Remove the driver plate coil and the associated wiring from pin #7 of V2 (12BY7) and driver tune (butterfly) capacitor.
- 4. Check to see that all parts from the driver plate and final grid are removed.



Closeup view of the new transmitter wiring.

The plate meter should also be removed before holes are drilled.

Mark the chassis for new holes by referring to the photos. Holes should be drilled with a small drill before enlarging for the chassis punch; use care when drilling so you don't damage parts left in the chassis. Holes for the crystal sockets require careful layout or much filing will be needed. New holes for the 6146 final tube sockets will have to be cut in the ventilation holes in the bottom of the final compartment. The tubes will now be mounted in the vertical position. Several stand off terminal strips must be installed for assembly of the new circuits; these holes should also be drilled before any parts are installed. When the holes have been deburred and all chips removed, the chassis is ready for installation of new parts.

Transmitter assembly and wiring

The new sockets can now be installed. If the 6146 sockets have no ground lugs, extra lugs will have to be installed. Install the mixer and driver coils as shown in photo-the new mixer coil is mounted under the chassis on an L-bracket. Position the terminals for direct connections. Wiring of the new mixer plate, driver, local oscillator and buffer should be done in sequence starting with the 12BY7 mixer plate. Be sure to leave room for the new driver capacitor and bracket. This capacitor should be installed last-refer to the photos and circuit diagrams for connections and layout. The new crystal switch mounts in place of the tune switch. Assembly of the final output circuit will require installation of a new coil with a better blocking capacitor. Start by installing the original neutralizing capacitor, modified plate choke and original dc bypass capacitor; position the parts as shown in the photo.

Modify the large loading capacitor by dis-

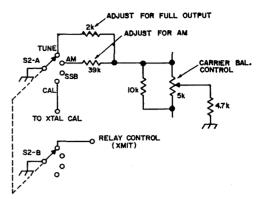
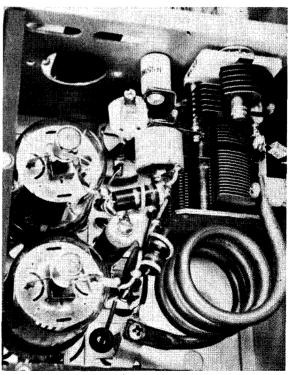


Fig. 3. Wiring the new function switch. S-2 is a double pole, four position rotary switch.

connecting the front half of the dual section. Use only the rear section. Remove two plates from the rotor and stator of the plate tuning capacitor and install the final tank coil. Use a brass strap from the stand-off to the plate tuning capacitor. Bend a "U" in the blocking capacitor bracket and install the new blocking capacitor. Also use a strap from the plate tuning capacitor as before.

Parasitic chokes must be used in the plate leads or the final will be unstable. Check back through all the wiring to insure that no wiring errors have been made. Be sure all bypass capacitor leads and socket pin grounds are very short. Use neat workman-



The new 50 MHz final amplifier showing placement of parts including the relocated rf choke. The small variable capacitor is connected in series with the original neutralizing capacitor.

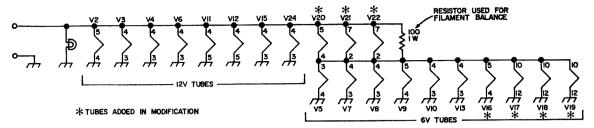
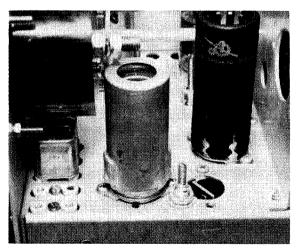


Fig. 4 New filament circuit for the modified SW—all others are original.

ship. Install the second mixer and driver plate tuning capacitor with a bracket, connect leads to the proper coils and install the front panel.

Receiver modifications

Since no room was available on the main chassis for the new rf and mixer stages, the 6 meter front-end and mixer were built on a small sub-chassis and attached to the VFO housing. This front-end consists of a 6CW4 cascode rf amplifier and a 6CW4 mixer. The local oscillator energy is injected into the 6CW4 cathode across a 47 ohm resistor. A double tuned output feeds the grid of the original 12BE6. The 6BA6 was originally used, but I found that the receiver had too much gain and excessive background noise. By eliminating the 6BA6 (V5) and feeding the first mixer directly to the 12BE6 mixer, the overall receiver gain is ideal. A very weak signal can be copied as well as on the more elaborate equipment I have available. The 14 MHz bandpass coupler must still be used between the two mixers for rejection of



The new local oscillator and driver tubes and crystal sockets are mounted below the meter. The extra hole in the foreground was evidently punched by a previous owner. Hole in the final compartment wall was for the original final socket.

120. The tubes indicated by an asterisk are added

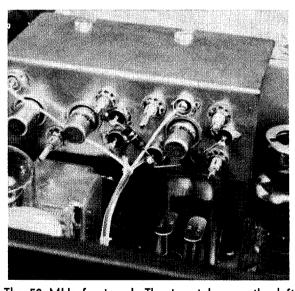
unwanted signals. A length of 50 ohm coax is used to couple the local oscillator injection and *if* output. The final output tank also serves as the receiver input. Coupling to the 6CW4 grid is provided by two 3 pF capacitors. On transmit the 6CW4 is cut off by switching bias to the grid as is done in the original circuit.

By referring to the chassis layout and circuit diagram, the new front-end can be built and checked out prior to installation. This completes the receiver changes except for the AGC and audio modifications.

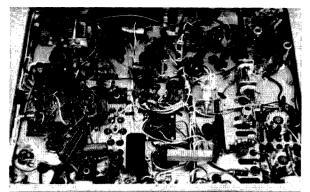
AGC and audio modification

As most persons know, the single band Swan has no AGC circuit or audio level control. With no control to hold the audio level at a pleasant volume, a loud signal blasts the operator out of his shoes before he can get the rf gain turned down. After using the transceiver a few days like this, I decided something had to be done.

In the original SW 120 the 12AV6 (V15)



The 50 MHz front end. The two tubes on the left are the cascode rf amplifier. A 3 pF capacitor connects from the feedthrough on the final compartment to the grid of the rf stage.



Under-chassis view of the modified transceiver. The local oscillator is in the upper right-hand corner, final sockets bottom right and mixer plate and driver center right. The new driver socket is partially hidden by the double tuning capacitor. The AGC circuit is next to the VFO dial plate. The new volume control and power switch are in the upper left-hand corner.

is a tune-up oscillator which generates a lot of excessive noise when tuning. This stage was converted to an AGC amplifier. Some early transceivers didn't have this oscillator.

The AGC system used is an audio derived method. The audio signal is sampled from the plate of the product detector and amplified. Finally, it is converted to a minus dc voltage which is proportional to the audio level. This voltage is than fed to the grids of the tubes to be controlled.

In this case the first rf and second if stages are controlled with the AGC loop. This allows the rf gain to be run full open. An audio volume control must now be used to adjust the audio level. The original rf gain control was moved to the hole which was occupied by the on and off switch. The new volume control with power supply

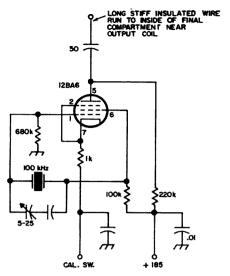


Fig. 5. Circuit of the 100 kHz crystal calibrator for the six meter Swan 120.

switch is now in the space left by the rf gain control. Two signals with extreme variations in strength now sound the same level in the speaker and very little popping or distortion is noticed even on loud signals.

The 50k pot marked AGC threshold should be adjusted with the antenna connectedadjust the control to give a residual voltage of -0.3 volts and a little kick on background noise from autos or static.

This AGC circuit works much better than any other version that I tried. I find it hard to give signal reports because most signals now sound the same strength. As stated previously, the quality of the stations received are still very good regardless of the signal level and I wouldn't be without AGC control. This circuit can be adapted to all the single band Swan transceivers whether modified to 6 meters or not.

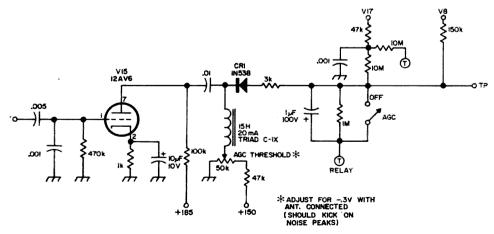


Fig. 6. Audio derived AGC system for the SW 120. This circuit is equally applicable to other single-band Swans.

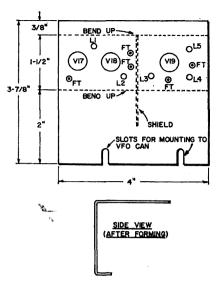


Fig. 7. Chassis for the 6-meter cascode rf amplifier and mixer circuitry.

Miscellaneous changes

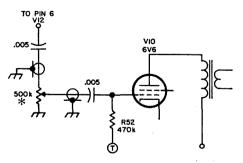
A new function switch is shown in the circuit diagram. This will allow the operator to insert carrier for different modes by simply turning the switch. Fixed resistors are selected for AM and tuneup modes.

A calibrator was installed for checking calibration. This switch is mounted in place of the old transmit-receive switch.

Adjustment and operation

Transmitter section

Preset all coils with a grid dip meter, disconnect the final screen and plate voltages, and check to be sure there are no short circuits and wiring is complete. Apply power and with the grid dip meter in the diode position, tune the local oscillator and buffer for maximum output indication. Turn on the transmitter, insert carrier and adjust the mixer and driver plate coils for maximum output at 6 meters. Set the VFO dial to the center of the range and peak up the 14



*MOVE RF GAIN TO OFF-ON POSITION MOUNT CONTROL IN HOLE MARKED VOLUME

Fig. 8. New audio volume control circuitry.

MHz bandpass coupler for highest level at 6 meters. Connect a voltmeter across the 10k bias resistor feeding the grids of the final tubes and again adjust all coils for maximum voltage on the meter.

Check to be sure the output is on 6 meters. The driver tuning capacitor should be set at near maximum capacitance for the low end of the band—this will allow coverage of 2 MHz or greater range. All coils should be peaked several times to make sure maximum output is obtained.

Neutralization

Connect a detector probe and VTVM to the final output jack. With the screen and plate voltages disconnected apply drive to the final and adjust the final plate and output capacitors for maximum reading. Next adjust the neutralizing capacitor for minimain output. Check to make sure the capacitor is not completely open or closed—it should be in the center range and the output reading low in relation to the original level. Now the screen and plate voltages can be applied and carrier inserted. Peak the driver tuning, connect the output into a good load, and tune up the final to about 230 mA with full drive.

Receiver

The new front-end should be adjusted for maximum gain before mounting to the VFO housing. Only slight peaking is needed for final adjustments.

The crystal calibrator is wired with a lead run into the final compartment and positioned about one-half inch from the final tank coil.

Final comments

This transceiver has proved to be a very worthwhile investment; the reports are excellent and it does a fine job. The final runs the same power as most other transceivers on 6 meters and will drive a 2 kW linear with power to spare. It makes a very handy rig for portable, mobile or just general use, and the Swan power supplies can still be used for fixed or mobile operation. With 6 meters looking up for the next few years, the VHF operator can get ready for lots of enjoyment from this conversion. Get your tools out and get to work.

. . . K6RIL

Maurice J. Shumaker WØHYB 3077 South Hurley Circle Denver, Colorado 80227

Military Quartz Crystals for the Radio Amateur

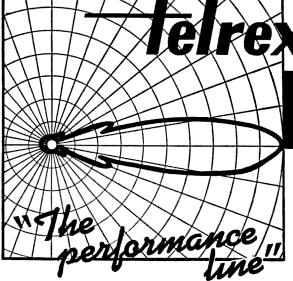
How to find crystal bargains

Surplus military quartz crystals are available at just about any frequency throughout the low and high frequency portion of the radio spectrum. These crystals can be very useful to hams and are available at modest prices from many electronic surplus houses or through some crystal manufacturers and dealers. Surplus crystals can be put to many good uses including transmitter and/or receiver frequency control, band pass filters, frequency standards and many others.

The writer has gathered together a lot of useful data on military quartz crystals and has presented it in tablular form (Tables 1 and 2). The information contained in the tables was derived from the "D" revision of the Military Specification MIL-C-3098, General Specification for Quartz Crystal Units. The table does not reference all of the 69, yes I said 69, types of quartz crystals used by the military. Rather, only the more common types frequently found in the surplus markets are discussed.

Holder Type	Pin Dia.	Pin Spacing	Holder Height	Holder Thickness	Holder Width
HC-5/U	0.156	0.812	2.205	1.817	1.594
HC-6/U	0.050	0.486	0.775	0.317	0.725
HC-10/U	0.062	N-A	1.055	0.560	N-A
HC-13/U	0.050	0,486	0.775	0.317	0.725
HC-18/U	0.017	0.192	0.530	0.150	0.402

Table 1. The dimensions of popular military crystal holders.



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			Military	Quartz Crys	tal Type	es		
ltem	Military Type	Holder Type	Frequency Range	Oscillating Mode	Freq. Toler- ance (%)	Reso-	Drive Level (mW)	Temperature Range (degrees C)
T	CR-15B/U	HC-5/U	80-200KC	Fundamental	±.01	Parallel		-40 to +70
2	CR-16B/U	HC-5/U	80-200KC	Fundamental	±.01	Series		-40 to +70
			15-25MC	3rd Overtone	±.005	Series		
3	CR-17/U	HC-10/U	25-50MC	5th Overtone			_	+60 to +80
4	CR-18A/U	HC-6/U	0.8-20MC	Fundamental	±.005	Parallel	5-10	-55 to +105
5	CR-19A/U	HC-6/U	0.8-20MC	Fundamental	±.005	Series	5-10	-55 to +105
,	CD 22/11		10-52MC	3rd Overtone		Series	_	-55 to +105
6	CR-23/U	HC-6/U	52-75MC	5th Overtone	±.005			
7	CD 24/11	HC 10/11	15-25MC	3rd Overtone		Series	_	-55 to +105
l ′	CR-24/U	HC-10/U	25-50MC	5th Overtone	±.005			
8	CR-25A/U	HC-6/U	200-500KC	Fundamental	±.01	Series	_	-40 to +85
9	CR-26A/U	HC-6/U	200-500KC	Fundamental	±.002	Series	_	75 ± 5
10	CR-27A/U	HC-6/U	0.8-20MC	Fundamental	±.002	Parallel	2.5-5	75 ± 5
11	CR-28A/U	HC-6/U	0.8-20MC	Fundamental	±.002	Series	2.5-5	75 ± 5
12	CR-29A/U	HC-5/U	80-200KC	Fundamental	±.002	Parallel		75 ± 5
13	CR-30A/U	HC-5/U	80-200KC	Fundamental	±.002	Series		75 ± 5
14	CR-31/U	HC-6/U	1-10MC	Fundamental	±.005	Parallel	_	-55 to +90
15	15 CR-32A/U	HC-6/U	10-52MC	3rd Overtone	±.002	Series	_	75 ± 5
15			52-75MC	5th Overtone	<u> -</u> .002			75 _ 5
16	CR-33A/U	HC-6/U	10-25MC	3rd Overtone	±.005	Parallel	2.5	-55 to +105
17	CR-35A/U	HC-6/U	0.8-20MC	Fundamental	±.002	Series	2.5-5	85 ± 5
18	CR-36A/U	HC-6/U	0.8-20MC	Fundamental	±.002	Parallel	2.5-5	85 ± 5
19	CR-37A/U	HC-13/U	90-250KC	Fundamental	±.02	Parallel		-40 to +70
20	CR-38A/U	HC-13/U	16-100KC	Fundamental	士.012	Parallel		-40 to +70
21	CR-42A/U	HC-13/U	90-250KC	Fundamental	±.003	Parallel	_	75 ± 5
22	CR-43/U	HC-16/U	80-860KC	Fundamental	生,01	Parallel	_	—30 to +75
23	CR-44/U	HC-6/U	15-20MC	3rd Overtone	±.002	Parallel	-	85 ± 5
24	CR-45/U	HC-6/U	455KC	Fundamental	±.02	Series	_	—40 to 十70
25	CR-46A/U	HC-6/U	200-500KC	Fundamental	土.01	Parallel		-40 to +85
26	CR-47A/U	HC-6/U	200-500KC	Fundamental	±.002	Parallel		75 ± 5
27	CR-48/U	HC-6/U	800-3000KC	Fundamental	±.008	Parallel		—55 to 十90
28	CR-50A/U	HC-13/U	16-100KC	Fundamental	±.012	Series		-40 to +70
29	CR-51A/U	HC-6/U	10-61MC	3rd Overtone	±.005	Series	20.0	-55 to +105
30	CR-52A/U	HC-6/U	10-61MC	3rd Overtone	±.005	Series	2-4	-55 to +105
31	CR-53A/U	HC-6/U	50-87MC	5th Overtone	±.005	Series	20.0	-55 to +105
32	CR-54A/U	HC-6/U	50-125MC	5th Overtone	±.005	Series	2.0	-55 to +105
33	CR-56/U	HC-18/U	17-61MC	5th Overtone	±.005	Series	2.0	-55 to +105
34	CR-56A/U	HC-18/U	50-125MC	5th Overtone	±.005	Series	2.0	_55 to +105

Table 2. Operating characteristics of popular military quartz crystals.

The next time you visit your local surplus store on a crystal buying spree, bring along the tables. You will find that they will be very useful as you rummage through the bins.

Table 1 can be used when selecting the crystal type to match a particular socket

and vice versa. Table 2 provides much needed information for designing the oscillator circuit of a receiver or transmitter or when trying to select an appropriate crystal oven.

. . . WØHYB

Converting the BC-728

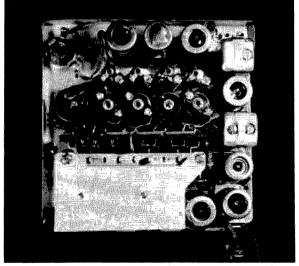
A low frequency superhet receiver for 160, 80 and 40 with a very attractive price.

One of the items you can sometimes find on the surplus market is the BC-728 receiver, a six tube superheterodyne battery operated unit for shoulder carrying. This unit is advertised by several dealers for the amazing price of \$7.95!

It is possible, for a bit extra, to buy the units complete with antenna, wet battery and charging cable. This antenna is a good deal if you are going to use the unit for portable use, the most logical application. This plugs into the antenna jack on one side, has a heavy cable with shoulder strap on it and the antenna fastens to the other side of the case. Thus the antenna feedline is used for the shoulder carrying harness. The antenna is telescoping for easy portability.

The case is rugged and most units are waterproof. If you have a selection you might pick out one with a sliding cover over the loudspeaker which would be very handy should you leave it out in the rain on Field Day.

The receiver has four pushbuttons inside to select the received channel. Channel one tunes from 2.0 to 2.6 MHz, channel two from 2.6 to 3.5 MHz, channel three from 3.5 to 4.5



Inside the BC-728. Note the large amount of elbow room. No crowding like most surplus gear!

MHz, and channel four from 4.5 to 6 MHz. While this was designed as a fixed channel receiver, you will find that there are tuning knobs right below each push button for tuning the channel. Thus, if you want to use the receiver for amateur use you can tune channel one, with a little padding, to the 160 meter band. Once you have peaked up the antenna and rf knobs you only have to tune the oscillator knob to cover the band.

Applications

For amateur band reception it is simple to slightly retune channel one for 160 meters. Channel three covers 75 meters as it stands, and channel four can be retuned to cover 40 meters quite easily.

Boating enthusiasts (or friends of boating enthusiasts) will find channel one worth more than the price of the whole unit for it covers the ship-to-shore bands and really brings them in with a wallop.

People having an interest in time and frequency standard signals (astronomy, piano tuning, watch adjustment, event timing, etc.) will find the receiver ideal. Channel one brings in WWV on 2.5 MHz, channel two tunes CHU on 3335 kHz, channel four tunes WWV on 5 MHz, and channel three can be retuned to bring in CHU on 7335 kHz. At least one of these should be available at all times of the day or night.

Conversion

Unless you are interested in wet nursing a wet battery it is a good plan to forget the beautiful vibrator power supply built into the case. This is designed to work with a 2 volt midget wet battery ("Keep upright when charging"). There is also a charging circuit with an external plug to go to a six or twelve volt battery. If you get the charging cable it should come with the battery clips.

Should you agree that dry batteries are

far better than wet (when one is inclined to forget about charging) then you can follow the next instructions. If you are planning to use the receiver for long periods then the wet battery would be a better deal, but for short periods of use dry batteries are ideal.

Step one: remove the power unit. Unscrew all of the bolts you can see coming through the outside case, bottom, top, back, and sides. Open the case and unscrew the knurled screw holding the antenna plug. This plate is also held by two small knurled knuts which will probably take a pliers to loosen. Lift the plate out and let it dangle. Unplug the power plug and gently lift the whole power supply, easing it out of the compartment. There is a little finger that extends into the power supply from the back of the case which will keep the unit from slipping out easily. You will have to work it out. Par for getting the unit out, counting all the screws and antenna plate, is six minutes.

The power unit can be relegated to the "junk box" for possible ravagement on future construction sprees. There are a lot of real nice goodies in it so don't give it the heave-ho.

Power cable

Your choice: remove the power connector socket from the power unit and connect the batteries to this or else remove the plug from the wires and connect them directly. If you decide to deplug the power line then keep track of the wires and connect them the same as you would with the plug.

Batteries

A number 6 dry cell is best for the filaments. They draw 300 mA at 1.5 volts, which will run down a flashlight cell pretty fast. And besides, there is plenty of room for the larger cell. A small 67½ volt portable radio battery will give more power than you need for the B plus and the drain is only 7 mA, so even the small #VS-016 batteries will give good life. You will also need a bias supply. Since there is no current involved here you can use small transistor radio or photoflash batteries. You will need about 7 volts, so a 7½ or 9 volt battery will do fine. Penlight cells, soldered in series are excellent and inexpensive.

Retuning the channels

Once you have gotten the receiver working and have checked out all the channels you are ready to retune. Let us take one specific channel and go through the process. For instance, if we want to move channel three so it will cover the 40 meter band, here is what we will have to do.

Since you will be about doubling the frequency of the channel you will have to remove about half of the windings from the three coils in that channel. Remove the shield can over the antenna coils and cut the connections to coil 3. The four small tongues can be bent back from the bottom of the coil form to release the coil. It is easier to remove turns when you have the coil right out there in your hand. Unwind half of the turns from the terminal end of the coil. Don't be afraid, make it a good generous half or you may have to pull it back out and pull off some more. Resolder the wire end of the coil to the terminal and put the form back into the set. Once the coil is soldered back in the circuit you can make sure you hit the right spot by checking it with a grid-dip meter and tuning the slug to both extremes to find out the new range of the antenna circuit.

Be very careful of the bottom end of the coil for if you should break the wire going from the terminal to the bottom of the coil you will have problems. The coil is wound with every other turn overlapped so that it is extremely difficult to unwind a turn or two from the bottom of the coil in order to give you enough wire to reach back up to the terminal. Better careful than sorry, to coin a phrase.

Step two is the rf stage. This is just as easy as the antenna coil. Do it the same way. There are not as many turns on this coil so you will only have to pull off about 30 turns instead of 40; run it down half way. Dip this one too if you have the instrument. Order a dipper if you don't have one so you'll be in better shape for the next conversion you try. Every ham shack should have a dip meter.

Now comes the p-d-r (piece de resistance), the oscillator. This coil is well shielded and, short of major surgery, you haven't a prayer of getting the coil out to work on. So? So work on it in the set. Warning: be careful. But don't worry, even if you louse everything up you can get back out of the predicament in a few minutes. Clip the wires going to the coil terminals from the set. Then clip the terminal board so that the two terminals are free. Next pry out the circular piece





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that keeps you from seeing down into the coil. Watch yourself on this move for you can break off one of the wires of the coil which come through the two holes in the circular piece. The upper terminal (on the rf coil side) is the bottom end of the winding. Lay that over the coil shield out of the way. Now reach down with a midget screwdriver and pull off the tape from the top of the coil. With that off you can unwind the coil turns freely. Pull off 35 turns. If you lose count don't worry about it. You can stop at any time and resolder the wires into the circuit and see where the oscillator is perking by turning on the set. A dipper won't give you much indication due to the coil shield.

When checking for oscillator range it is handy to have a signal generator on hand. This is another pretty basic piece of test equipment for the well run ham shack. Lacking this basic unit you can always tune in a distinctive signal and hunt for it on your regular all-wave receiver. Good heavens, don't you even have that?

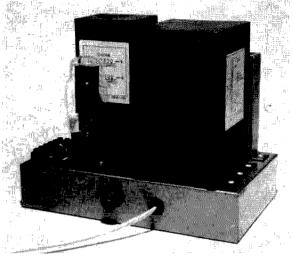
When you are all through pruning the coils it wouldn't hurt any to paint on a bit of coil dope to hold them together.

What's that Elmer? You say you broke the wire on the oscillator coil and don't know what to do. Well, in that case you can pull off all the wire from this coil and scrape the form as clean as you can. Then you wind up a new coil for yourself out of #31 enamel covered wire (or #29, 30, 32 etc.) and slip it over the form, holding it in place with the aforementioned coil dope. About 35 turns should do.

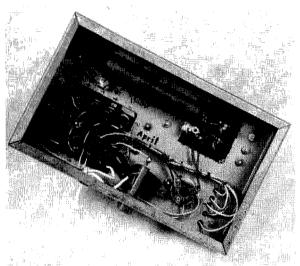
Antenna

The AN-75-C antenna, which was designed for the BC-728, is the best deal, but you may have some trouble locating it. For some obscure reason the antennas seem to have gone one way and the receivers another, though both are available in quantity. Should you decide for one reason or another to do without the AN-75-C you can get fine results by connecting a short length of wire to a Motorola type plug. Fifteen feet works well. You can coil this up and carry it inside the set when not in use and then fling it up into a nearby tree or house for operation. Or you can put a clip on the end of the wire and connect onto more ambitious wires. When changing antennas remember to open up the set and retune the antenna circuit for maximum volume.

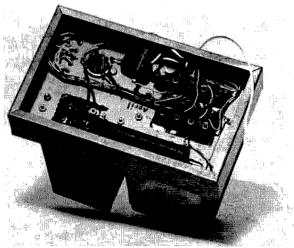
W. R. McCullagh VE3DAN McCullagh Studio 73 Simcoe Street Toronto, Ontario, Canada



Power supply. The picture was taken with Ilford Pan F film in the 4×5 inch camera. There was one spotlight overhead.



Bottom view of power supply. The camera used was a Cannon FX with a 50 mm lens. Photofloods in reflectors, no diffusion. Tri X film.



Underneath the power supply. The 4 x 5 inch camera was used, with diffused lighting.

Photographing your Electronic Gadgets

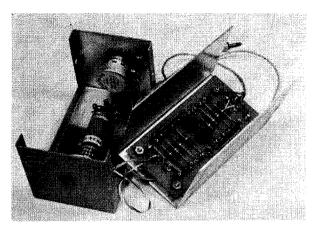
Practically every article in radio publications uses at least one photograph. Some of these are good, some are excellent—but a lot of them are poor. Yet I have never seen an article on how to photograph equipment properly, so here goes.

The amateur writing about his electronic gadgets is naturally going to use whatever camera equipment he has. If he did have a choice of equipment what would be best? A large view camera with tilting front and back, even if it is an old one, is tops; with this he is able to correct converging verticals.

The professional photographer uses a 4 x 5 or 8 x 10 inch camera, but it is possible to take good photographs with a box camera. A tripod or camera stand is a must, the heavier and sturdier the better.

Almost any lens will take a good photograph when closed down, as it should be to get everything in focus. For the small camera a long focus lens is best, except for detailed close-ups.

Lights don't need to be elaborate; photofloods in reflectors, reflector floods and even an ordinary lamp hand held is quite usable, as is the ordinary room lighting. Flash lamps



Balanced transistor amplifier for photovoltaic cell light meter. This shot was taken with a 4 x 5 inch camera.

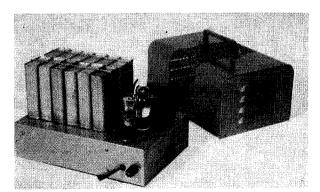
aren't very good and electronic flash isn't much better unless you really know what you are doing.

As the camera should be on a stand or clamped to something solid, fast film isn't necessary. For a small camera slow, fine grain film usually makes a better enlargement, although some of the newer fast films, such as Kodak Tri X, are excellent. Don't forget the exposure meter; most camera users have one and should know how to use it.

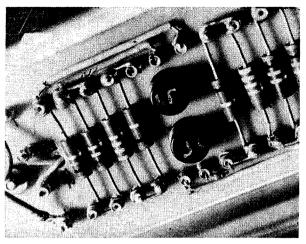
If you are using a view camera, don't forget that a close-up photo requires more exposure. See your camera manual regarding this. This is needed because of the additional bellows extension.

For a background, use a white card or unwrinkled white paper available from art supply houses.

Most editors like a large print, preferably 8 x 10 inches, so an enlarger is needed unless a friend or drug store is making the prints.



High voltage flash unit, with protective cover. A 4 x 5 inch camera with two diffused lights was used.

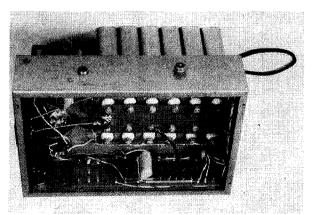


Closeup of a balanced transistor amplifier. The camera—Edixa reflex, with a Novoflex 35 mm lens. Tri X film.

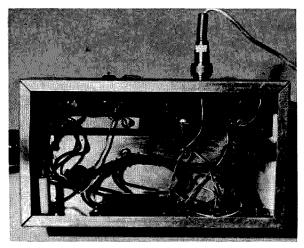
Reflectors to lighten up shadow areas may be white cards or even a newspaper and some diffusing material such as tracing paper or cloth, although glass cloth is the preferred material.

Looking over a number of radio magazines the most common faults in the photographs seem to be blurring, probably due to improper focusing or movement of the camera; and brunt out faces, due to having a flash on the camera too close to the subject. We musn't rule out poor engraving and printing, over which the photographer has no control. However, if the prints submitted aren't overly contrasty or soft and mushy, but are sharp and have a full range of tones from lights to darks, the chance of good reproduction is good.

Which brings up to the subject of process-



Inside view of the high voltage flash unit. The large connector is used because of extremely high currents which may peak at 800 amperes at 2500 volts. Definitely not for the beginner.



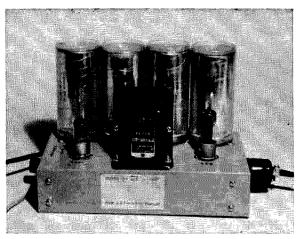
Inside the 50 watt second power supply. This supplied the power to take this photograph. The light was harsh, undiffused.

ing. The film and paper manufacturers have spent large sums of money working out the proper processing for their materials, and are anxious to have you get the best results possible. They should know what's best for their products, so it's a good idea to follow the instructions in the package.

To sum up. First, have a good solid support for the camera. Take the time to arrange the subject. Try a number of angles. To be sure of the best exposure; take a few extra shots at different speeds—film is cheap.

If possible use a lens of longer than "normal" focal length to get better perspective and possibly a short focal length lens for very close up shots. Use a small aperture for greater overall sharpness and use fine grain film if you are using a small camera.

Avoid harsh lighting, and over or under development of the film. Make a print on



The flash for this photograph was provided by the low voltage power supply pictured. 4 x 5 inch camera used.

glossy paper with full tonal range. The editor likes lots of pictures.

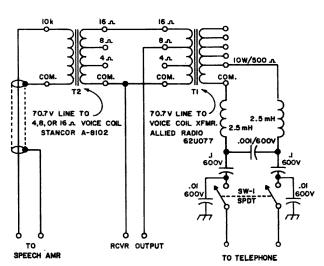
As the great majority of my work is done with large cameras, and as they were available and I feel more at home with them. I used a couple of Speed Graphics, one with a 127 mm Ektar lens, the other with a 135 mm Zeiss Tessar lens. There is no discernible difference in results. I also used a Cannon FP Reflex with a 50 mm and 135 mm lenses and an Edixa Reflex with a Noflexar 35 mm lens, which will focus down to about two inches from the object.

For the 4 x 5 cameras I used Ilford FP3, a fine grain film; for the 35 mm cameras I used Kodak Tri X film and IlfordPan F, an extremely fine grain film. I imagine the editor would find the Tri X acceptable, although fairly grainy. I doubt if this would show when printed.

Why Fight Ohm's Law and Lose?

An article by K5HPT in the October 1963 issue of 73 described a simple phone patch. The title was "Why Fight Ohm's Law?" Well, I did—and lost. It was a big hum of a mess. So John WA4CUA and I experimented and came up with the circuit shown. I used two transformers back to back and added rf bypassing. I have had several requests for a drawing of the patch by those who have heard it on the air.

. . . Roger Williams WA4KWC



Panoramic Display from the AN/APA-38 Indicator

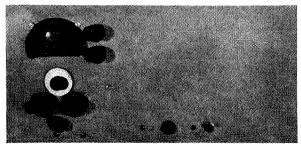
A simple, low cost approach to panoramic reception.

A very attractive item for the VHF enthusiast is the AN/APA-38 panoramic indicator. It is an earlier version of the IP-69/ALA-2 indicator whose conversion was described in the June 1964 issue of 73 *Magazine* and is currently available for under \$20.

The APA-38 was originally used with the APR-1 and APR-4 receivers for identifying radar signals. Basically it is a superheterodyne receiver whose output is a video signal applied to the vertical plates of a cathode ray tube. The input center frequency at 30 MHz is heterodyned to the 6.5 MHz if by a sweep oscillator. The frequency limits of the sweep oscillator are controlled by the sweep width control—at its maximum position the indicator will display the spectrum \pm 5 MHz of the center frequency.

In addition to the conventional panoramic display, two sweep positions are provided. These sweep ranges (PRF-1 and PRF-2) cover 30 - 1500 hz and permit using the indicator as an oscilloscope for analyzing the modulation of the incoming signal.

Since the indicator was originally designed to operate from a 400 Hz supply, it must be converted to 60 Hz operation. To do this remove the following components: power transformer T-104, high voltage rectifier V-



Sam's neat rack-mounted panoramic indicator. Although the center frequency of this unit is 30 MHz, other *if* frequencies may be used with a simple heterodyne converter.

105, low voltage rectifier V-110, and choke L-101. While you are at it, remove the front panel and the power supply cage.

The 60 Hz supply could be built in the space made by removing the 400 Hz components. However, building it on a separate chassis not only makes construction simpler, it reduces the AC coupling problem and shortens the unit so that it will fit into a 16 inch deep rack.

Build the supply as shown in **Fig. 1.** The need for a special oscilloscope transformer was eliminated by using a voltage doubling circuit for the CRT negative high voltage supply.

Replace the old front panel with standard 8-3/4 inch rack panel. The CRT viewing hole is easily cut with a saber saw. The power supply should be mounted to the panel with a bracket and supported with a shelf. The rf input connector is replaced with a BNC type mounted on the rear of the power supply chassis.

After wiring the power supply, check the indicator for proper operation. Allow it to warm up and advance the brilliance control until a trace is visible. Set the function switch to PAN. Turn the gain control fully clockwise and position the trace along the base line using the horizontal and vertical position controls. Sharpen the trace with the focus control. Couple the output of your signal generator (or grid dip oscillator) to the input connector. With the sweep width control fully clockwise, tune the signal generator from 25 - 35 MHz and observe the pip. Set the signal generator at 30 MHz and center the pip using the center control frequency. The height of the pip should be reduced with the signal generator attenuator until it is not over-loading the display.

Modulate the signal generator with a 400

73 MAGAZINE

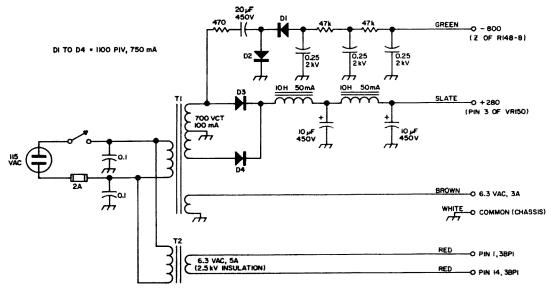


Fig. I. An AC power supply for the converted AN/APA-38 indicator.

Hz signal. Place the function switch in the PRF-1 position and adjust the sweep control until the signal locks in, and the modulating sine wave is stationary on the CRT.

The indicator is now ready for use. Couple the 30 MHz if of your receiver into it and you are ready to go. If you have an if other than 30 MHz you can construct a simple heterodyne converter to convert it to 30 MHz.

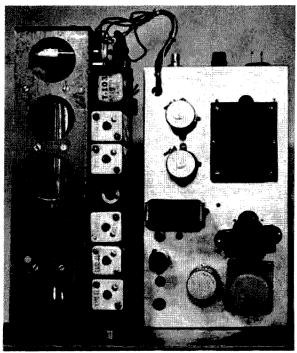
On the air experience is the best way to become familiar with the operation and uses of a panoramic display. The following is a brief guide to signal identification:

- 1. A CW or unmodulated carrier appears as a pip of fixed height. If it is a keyed CW signal the pip will appear and disappear with the keying. With a little practice you can copy CW visually!
- 2. AM signals will appear as a pip of fixed height when no modulation is present. With low frequency modulation the waveform will look like a broad response curve. As the frequency of modulation increases you can observe the sidebands moving away from the carrier.
- 3. SSB two tone test signals appear as two carriers of slightly different frequency. If the tones are closely spaced they will generally appear as a single deflection varying in height.
- 4. An MCW signal will appear like a CW signal, varying in height as the transmitter is keyed. If the modulating

frequency is high it will be possible to distinguish the sidebands.

5. An FM signal appears as a multitude of discrete pips. The amplitude of the pips is a function of the modulation index. The spacing between pips is a function of the modulating frequency.

... W6JTT



Top view of the converted, rack-mounted AN/APA-38 panoramic indicator. The surplus unit is on the left, and the new 60 Hz power supply is on the right.

RDR Receiver Conversion

A simple conversion of the RDR receiver to cover the 220 MHz band.

Conversion of this receiver to AC operation with crystal or external VFO operation is a worthwhile project for the ham who wants to listen in on the 220 MHz amateur band.

Remove the chassis from the cabinet by loosening the twelve screws around the front edges. Pull out the chassis and by depressing the tabs on the sides, completely remove it from the cabinet. Now, remove everything from the dynamotor compartment, including all wiring, the fuse holder and base by removing four screws along the outside edges. Remove the cover from the crystal and intercontrol compartment by removing fourteen screws. Pull out the crystal oven and oven socket, leaving the two heavy wires as long as possible.

Remove all the automatic tuning system

except the multiplier and rf dial mechanism. Also remove the two long rods and associated gears that run along the top and bottom rear of the compartment—this has a short shaft coming straight out the front in the middle of the compartment. Add a coupling to this shaft so it will protrude through your new panel and you will be able to tune both the multiplier and rf controls simultaneously.

Cut out a 5 by 12½ inch panel to mount where the former oven, rf and multiplier cables were covered. Cut out holes for the multiplier and rf dials—also the tuning control, crystal socket, B+ switch, AC switch, pilot light and speaker. Cut a panel 6½ by 10 inches to fit the dynamotor compartment; this is for the new power supply. Wiring is simple, as all parts are labeled. Cut out R112 on top behind the front panel. The transformer filament windings go to terminal

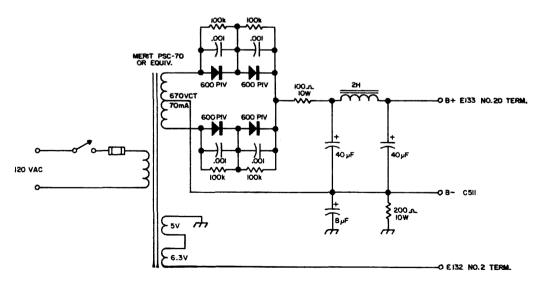
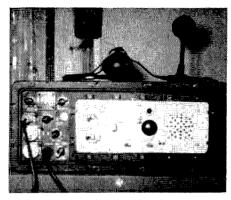


Fig. 1. AC power supply for the RDR receiver. The completed supply is mounted on a small panel which is mounted in the original RDR dynamotor compartment.



K3HIL's converted RDR recevier. Bob used a 4937 kHz crystal to cover the Gemini astronaut's 296.8 MHz communications frequency.

number 3 on terminal strip E132. The other end of the wiring goes to ground.

Label original pilot light connections for future reference. The B+ connects to terminal number 20 on terminal strip E133. The B- is connected to C511 on the back end of the multiplier section. The speaker and output transformer are connected across the phone jack terminals under the *if* strip cover. Install a crystal socket (FT243) on the front panel and connect it to the two heavy wires going into the multiplier stage. Install the switches, pilot light and speaker on to the panel—now you're ready for the smoke test.

Tune the receiver as follows: insert the crystal, rotate meter switch to position 1, unlock multiplier dial and adjust for a reading of 5 to 7 on the meter. Turn the meter switch to position 2, readjust multiplier slightly to obtain a reading of at least 4 on the meter. At position 3 unlock the rf dial and rotate for maximum noise and a minimum reading of 7. Position 4 is the plate voltage of receiver—normal reading 7; position 5, filament voltage, normal reading 7.5. The other positions are not used.

Crystal control was desired in my case but the multiplier tuning capacitor has a rather large range which can be used to tune the oscillator. The crystal frequency is doubled, then tripled 3 times—a total multiplication of 54. The *if* frequency is 30.2 MHz.

To determine what crystal frequency you require, subtract 30.2 MHz from your desired receive frequency and divide the result by 54. For example, to receive 222.5 MHz, 222.5–30.2=192.3 MHz. Dividing by 54: 192.3/54 = 3.561. A 3561 kHz crystal would be required.

... K3HIL



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Build a 40-Meter Rotatable Dipole

This shortened dipole is little longer than a 20-meter quad.

A few months ago I built a wooden tiltover tower, which to my amazement, worked very well. After I completed that project, I worked a few more weeks looking for parts for my "Triband Quad" to put on top. Up to this time I had been using, and very successfully, an all-band antenna.

With the erection of my "Triband Quad" I found that I could not keep the all band antenna up anymore, because there was some interaction with the quad and I could not get the SWR down when the quad was pointed in the direction of the other antenna.

I had to come up with something that I could put up that would not interfere with the quad. My property is not too wide, but it is long. If I put up a dipole it would run in the wrong direction to be effective. To put a half wave rotatable dipole up was out because I could not get past a nearby tree, mostly in my neighbor's yard. Hence, this shortened version of the 40 meter dipole.

I needed a plate to attach my quad to the mast, and I knew where there was one, which I bought for five dollars. The owner also threw in the rest of the antenna which had come down in a wind storm. After careful observation I noticed that the driven element was in good condition, and that it could pos-

sibly be placed in between the quad.

I figured that by placing a bamboo pole into either end and by taping a wire along the pole, it would work but again it could not be over 30 feet. The commercially built four band beams have a 40 meter section close to 39 feet.

Electrical

Fig. 1 shows the idea of the dipole. It consists of a ten meter section of an old driven element—a coil attached to the end of it, and a length of wire attached to the coil, that will resonate at 7.1 MHz.

There are several ways to construct the antenna at the mast. It may be done as seen in Fig. 2, or a dowel may be used as an insulator and the aluminum may be placed over the dowel. Any other way may be incorporated as long as there is a space between one side of the antenna and the other; also one must remember to keep it electrically insulated from the mast.

The length of the wire was 19 feet at the beginning. I also started with 20 turns of 3" coil. My first job was to get the one leg to resonate at 7.1 MHz. This was done by winding four turns of soft drawn wire around a grid dip meter and finding the right spot on

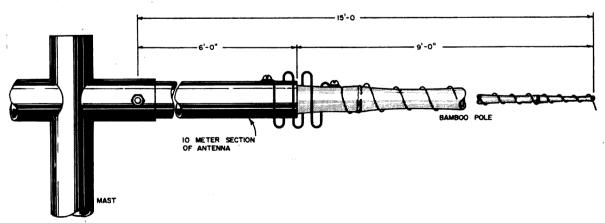
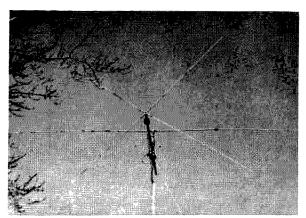


Fig. 1. Construction of one arm of the shortened 40-meter rotatable dipole.



Here's the dipole in place between the two elements of the quad.

the coil. See Fig. 3 The next step was to wind the wire very carefully around the bamboo pole so that each turn was about 1" apart. I did this until the 19' were completely used up. I checked the grid dip meter again to make sure that there was no change in resonance, and there was none.

At the coil I began moving the tap so that I would add two or three turns to the coil, while I snipped the wire at the other end to resonance. You may leave the 19' of wire on the pole. You may also make it shorter by adding more turns to the coil than I did.

Attach the coil with two stand off insulators so that the bamboo pole is approximately in the center of the coil. After I found the length of the dipole I wanted, I soldered the wire to the coil, and I drilled a hole at the end of the bamboo pole, and put a small nut and bolt through it. To this I attached the other end of the wire.

That being completed I did exactly the same thing to the other leg. Knowing the

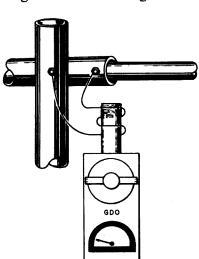


Fig. 3. Getting one arm to resonate at 7.1 MHz.



Fig. 2. One way to connect the antenna to the mast.

approximate number of turns on the coil, and the number of turns on the bamboo pole it took half the time to fix the second side. After completing the second side I put two coats of varnish on the bamboo poles and over the wire, I coiled over the bamboo pole.

Now that I had both sides completed, I again checked resonance by placing the coil around the grid dip meter, but this time the wire was attached to either side. See Fig. 4 The meter should dip as you move it through the coil without any further adjustments.

Feeding

Feeding the dipole may be done three ways. One, feeding it with balanced twin lead as I did; two, feeding it with 72 ohm coax; or three, any other feed line with a balun. Make sure the feed line runs away from the antenna at a right angle as much as possible. I have mine running right to the ground, a total of 38' before it comes into the shack, where I tune it with a match box.

The SWR seems to rise sharply toward

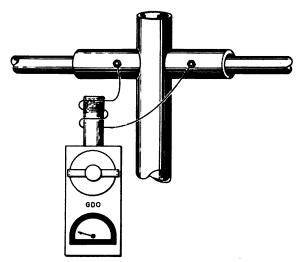


Fig. 4. Checking the resonance of the whole dipole.

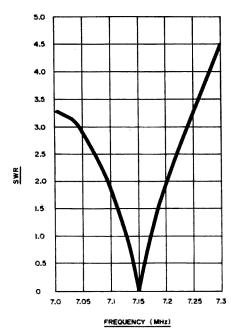


Fig. 5. SWR of the antenna fed with balanced twin lead through a Matchbox tuned at 7.15 MHz and the transmitter frequency varied.

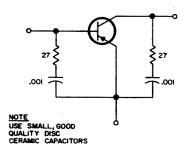
the high end of the band. See Fig. 5 I have found that I can get a one-to-one reading at the transmitter using RG86/U 205-ohm balanced line.

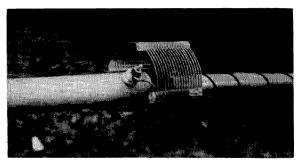
Performance

I found that the quad works perfectly without any interaction between it and the

Is Your Heathkit Transistor Tester Running Wild?

The scene was an industrial electronics laboratory, not so long ago. Our Heathkit Transistor Tester Model IM-30 had been absorbing a considerable amount of skilled engineering talent for almost the entire morning. It seemed perfectly healthy, but gave erratic readings on a batch of expensive new silicon transistors. As the general atmosphere was becoming rather warm, a little bit of the old light began to dawn . . . Do you suppose this XXXX thing could be





Here's what the coil between the ten meter section and the bamboo pole.

dipole. Don't try to feed the dipole with the same feed used with the quad; it will not work. You must use a separate feed line.

I also found that there seems to be a slight gain in strength when the dipole is at a slight angle to the person you are working. I have had one DX contact in Venezuela with a 5 x 7 report. I have held my own through the QRM on 40 meters. It's not a cure-all by any means, but it beats not having any antenna at all on forty. Also you can rotate it along with your quad. Its weight is relative to the weight of the quad. As you can see, I have it up on a wooden tower and it seems to be holding up fine. All in all, I would say it should cost you about \$5.00 at the most to build.

Good luck and hope to hear from you on 40 meters.

oscillating? It turned out the oscillations could be stopped by applying a fingertip to one transistor lead. The tests were rapidly completed and with a loud roar the focus of attention turned elsewhere.

Recently, I almost failed to recognize this same problem while checking some surplus 25c transistors. Then I realized the difficulty would have to be worked out. Using my James Dandy Mixer (73, August 1966) I spotted the oscillation at about 130 MHz. And after one or two false starts I found an appropriate circuit modification.

Fig. I shows how I stopped the oscillations by loading the transistor at rf but not at dc. The components are installed in the best VHF style close to the transistor socket. An extra test socket on short leads required the same treatment although it is used with the modified tester. I hope you'll put in the emitter-base and emitter-collector branches first time around! It takes both of them to do the complete job.

... James Ashe W2DXH

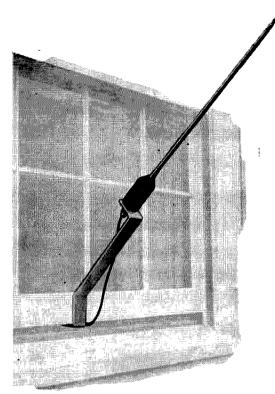
The Vacationer Portable Antenna

How often when checking into a hotel or motel for the night, or if you live in a non-cooperative-landlord apartment, have you wished you could get on the air without causing an upheaval? Well now you can: The Vacationer Portable Antenna is the answer.

The Vacationer Antenna is unique in the fact that this base loaded whip becomes a center-loaded antenna with very low SWR due to the simple wire counter-poise that is clipped onto the window mount and extends inside the room. Places are indicated on the counter-poise wire for the best match on each band. If an SWR meter is inserted into the line, it is possible to get a 1:1 ratio easily.

For use on 20, 15 and 10 meters, suitable loading coils are provided, and are attached to the base of the whip with removable screws. For two and six meters a shorting bar is furnished. The Vacationer is ruggedly constructed. The base is of molded unshatterable nylon; the machined parts are made of nickel-plated brass, and the window mount is weather resistant aluminum.

With this portable antenna, going together quickly and easily, one can be on the air in less than 5 minutes. It is de-



signed to handle any of the 300-watt PEP transmitters, or 180 watts AM or CW.

Come hurricanes, sleet or ice storms, when beams and outside dipoles collapse, The Vacationer, as an emergency antenna, will keep you on the air; very economical insurance. The Vacationer folds down to 19 inches, so it can be packed in a suitcase, it is sold by the DPZ Corporation, P.O. Box 1615, Jupiter, Florida, 33458, and retails for \$24.50.

. . . **K**1RA

AC Ammeter

Have you ever wondered just how much current that transmitter is pulling from the 120 Vac line, but don't want to get into the expense of a good AC wattmeter? Here is a low cost adapter for making such power measurements with an AC voltmeter. The voltmeter should have a sensitivity rating of at least 1000 ohms per volt. Almost any vom or vtvm in the shack should meet this requirement.

The adapter consists of an accurate 1 ohm power type resistor mounted in a ventilated housing provided with terminals for connection to the AC line, voltmeter, and power consuming device. This resistor converts the voltmeter into an AC ammeter. At any deflection of the voltmeter the reading is

directly in AC amperes. To convert to watts drawn by the load, multiply the deflection by the line voltage. Example meter reads 0.65 volts and line voltage is 120 Vac. 0.65 x 120 = 78 watts. This is only accurate for a resistive load, but will give a relative reading on others.

Above 500 watts the voltage drop across a 1 ohm resistor becomes large enough to reduce the voltage applied to the device under test. If higher power levels are to be measured, the resistor should be reduced to .5 or .25 ohm.

DC power drain can be measured by substituting a DC voltmeter in place of the AC voltmeter.

. . . Don Marquardt K9SOA

Operating the BC-611 Walkie-Talkie

BC-611's are now available and are very useful for short-haul communications and locating sources of intereference.

The BC-611 is a press-to-talk portable radiotelephone designed to transmit and receive signals over the frequency range 3.5-6.0 MHz. Its range is short because of its low power (% watt output), and could be anything from 100 feet to one mile. Over salt water, a three mile range might be obtained. These units are currently available and are being used for short haul work in the MARS circuits.

Power requirements are 1.5 Vdc for the filaments and 103.5 Vdc for the B plus. Originally, the batteries were designated as BA-37 (1.5V) and BA-38 (103.5V). Either the Burgess XX69 or the Eveready W361 are commercial equivalent B batteries but the 1.5 volts may be obtained from two flashlight C cells in parallel and an FT-501 adapter.

Extension of the telescopic antenna to its full length actuates a toggle switch to energize the unit. The receiver is a superhet circuit and contains a crystal controlled local oscillator. The transmitter section consists of a crystal oscillator, power amplifier, speech amplifier, and plate modulator. All of the tubes except one serve double purposes. Tube VI (3S4) serves as the rf amplifier in the receiver and as the power amplifier in the transmitter, tube V2 (1R5) functions as the converter-oscillator in the receiver and as the oscillator in the transmitter, tube V4 (1S5) operates as the second detector-avc-af amplifier in the receiver and as the microphone amplifier in the transmitter, and tube V5 (3S4) serves as the output amplifier in the receiver and as the modulator in the transmitter. Tube V3 (1T4) operates as the if amplifier in the receiver.

The push-to-talk switch is a 7-section, double-pole, double-throw switch. Some of the surplus units may be received with broken switch handles. It is possible to fashion a new switch handle made from a piece of plastic.

The transmitting frequency is determined by the particular crystal used; to receive stations operating on the same frequency it is necessary to use a receiver crystal 455 kHz higher than the transmitting crystal frequency.

To tune the receiver for maximum performance on a specific frequency, adjust C7 and L2 for best reception of a received signal. There are two methods for tuning the transmitter's output. The best way is to use a field strength meter and adjust C12 for maximum meter deflection. The second method is to insert a milliammeter in the plate circuit of the rf power amplifier (remove jumper inside bottom cover and insert meter) and adjust C12 for maximum meter deflection (dip).

The BC-611 is part of Radio Set SCR-536-A, -B, -C, -D, -E, and -F and the technical manual is TM 11-235. The test set for the SCR-536 is designated as Test Unit 1-135. Loop antenna AN-190 (not supplied with the unit) is a directional loop antenna with a built-in sensing device and can be used for homing purposes in conjunction with the BC-611. When equipped with the loop antenna the BC-611 should make an excellent unit for tracing down local interference sources and should appeal to amateurs possessing fixed direction finding equipment.

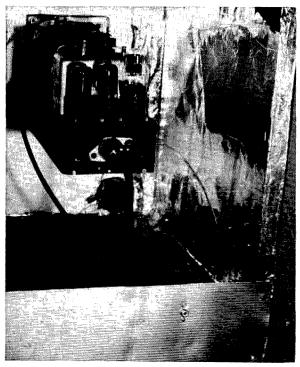
... W1MEG

A Poor Man's Transmitter Cabinet

Judging by the appearance of some ham shacks, proper packaging of the equipment presents a major problem to the roll-your-own amateur. Many transmitters sound wonderful on the air, but look like something the junior operator dragged in from the junk yard. These eyesores can be dangerous to the operator and to any visitors to the shack.

After putting up with poor packaging at my station for a time, I decided to act. This article describes how the problem was solved; the finished transmitter cabinet meets the following requirements:

- 1. Complete enclosure to keep children out of the wiring.
 - 2. Adequate TVI shielding.
 - 3. Pleasing appearance.



Inside view of the TV cabinet showing the aluminum foil shielding and the Command Transmitter mounted on the front panel. Note that the foil extends over the back of the cabinet to the edge of the wood frame; this overlap provides generous metal to metal bonding when the rear shield is in place.

- 4. Adequate space for a complete medium power transmitter.
- 5. Construction possible with only simple tools.
 - 6. Low cost.

My transmitter cabinet provides 7.5 cubic feet of usable space for less than five dollars; with a little effort the average amateur can duplicate this in a modest workshop. The finished product will adequately house an AM transmitter of several hundred watts or a SSB transmitter running the legal limit.

The basis of this project is a used floor model TV cabinet. Many enterprising amateurs find a wealth of usable parts in old junked TV sets; why not use the cabinet too? There are many old TV sets around with large wooden cabinets available for the asking. A friend gave me the one I used. A plastic cabinet might be usable, but wood is easier to work with. A table model cabinet would be excellent for a small transmitter.

Here's how I converted my cabinet. I lined the cabinet with a heavy grade of aluminum foil on the inside top and sides and a piece of sheet aluminum on the bottom and front. The front panel must be heavy enough to support the weight of any attached equipment. A better job, though more expensive, could be done with lightweight sheet aluminum throughout. In any case, allow generous overlap and metal to metal bonding at the joints. A long crack lets out quite a bit of rf energy. I attached the foil with glue and staples.

The back of the cabinet has a door which is easily removed. In the cabinet shown in the photograph, copper window screen was stretched over a thin wood frame, but a sheet of thin aluminum sheet perforated with small holes would be better. In any case the material must preserve the shielding and permit free circulation of air; for high power transmitters, the use of a blower should be considered.

The best shielding in the world will not

prevent TVI if the leads leaving the shielded enclosure are not filtered. A simple length of shielded hook-up wire bypassed at both ends *might* provide adequate filtering, but I used the more elaborate filter shown in Fig. 1. I built a metal box from an old tin can with tin ships, pliers, and a propane torch. Although not attractive, it cannot be seen when mounted in the cabinet.

The bypass capacitors might work better inside the box than out, but they perform well in this unit and were more easily mounted on the outside. I mounted them with very short leads close to the point where the coil lead passes through the box. Ceramic feed-through insulators should be used for circuits carrying high voltage.

The coils must be wound with wire adequate to carry the current. The only place where this might present a problem is in the heater leads. The coils were wound on a section of 3/16 inch rod; they are self supporting when used with very short leads. About one inch of close wound number 26 wire was used for all coils except the one carrying heater current; this coil was wound with number 18.

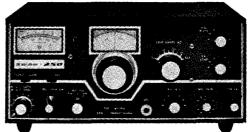
The bypass capacitors were disc ceramics salvaged from old TV receivers, except as a safety precaution I used new capacitors for the high voltage leads. The photograph shows the filter mounted in the cabinet with five leads rated at below 1000 volts. A high voltage filter will be mounted immediately in front of the present filter when the medium power final is completed.

I feel that I have met all six requirements set forth in the beginning of this article; the transmitter is completely enclosed and quite safe from contact with high voltage. At the present time this cabinet is pretty large for the command transmitter and its power supply, but there is room to expand; I am working on an 813 final for more power.

No trace of TVI is observed on any of the area television stations located 40 miles away. My own TV receiver has no high pass filter and is several years old. When the transmitter was operated outside the cabinet and without lead filtering I experienced severe TVI to both sound and picture.

Do not let the do-it-yourself urge be suppressed by the lack of a proper cabinet. Find an old TV cabinet and package that rig! . . . WA4RHT





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Micro-logic for Non-logical Users

The title is not meant to imply that amateur operators are *illogical* in any way, but rather to identify this article as one in which integrated circuit (IC) logic elements are used in ways for which they weren't specifically designed. That is, it will attempt to show some of the many ways that amateurs can use digital IC's in circuits that are noncomputer oriented.

Historically, there are two reasons why the digital IC (micro-logic) became readily available at low cost before the linear IC. One of these reasons was the rapid growth of the digital computer industry; increasing both individual computer size and the number of computers in production. Size, cost, and reliability requirements of the new digital computers offered a rich prize to the semiconductor industry if it could come up with an IC to suit computers. The second reason digital IC's came first is the fact that logic circuits are easier to make than linear circuits. Logic circuits generally require only that their transistors be in one state or another (for instance, "on" or "off") and this requirement is relatively easily met by mass production units.

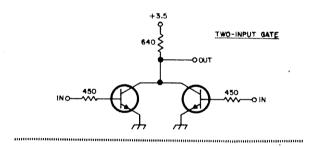
Out of all the research that was poured into the realization of the digital IC for the computer industry, several "logic families"

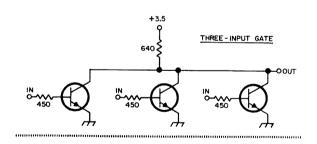
> +3.5 640 IN 0 450

Fig. 1. The basic transistor gate.

of IC's emerged. These logic families have all made successes in computer use to one extent or another and no one family has yet obtained a clearcut advantage over the others on all counts. The present major logic families are: Resistor Transistor Logic (RTL), Diode Transistor Logic (DTL) Transistor-Transistor Logic (TTL), and Emitter Coupled Logic (ECL).

RTL Integrated Circuits have become the





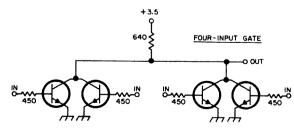
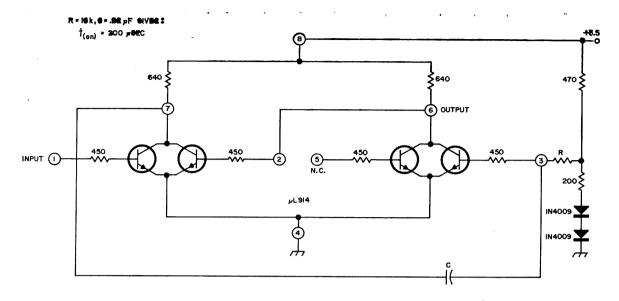


Fig. 2. Various gate arrangements—two input, three input and four input.



MONOSTABLE MULTIVIBRATOR

Fig. 4. A monostable multivibrator using the μ L914.

least expensive, most available IC's on the market. In small quantities (1-99) the price of a simple J-K flip-flop has dropped to \$1.35 and that of a dual two-input gate to \$.80. A number of semi-conductor manufacturers, Motorola, Fairchild, Sperry, Texas Instruments, and others all make the RTL line; and at least between *some* units, voltages are compatible. There are two mainly-used packages, the TO-5 can with 8 or 10 pins and the "Dual-Inline Package" (DIP) with 14 pins.

The basic building block of the RTL family is the gate shown in Fig. 1. This gate can be expanded into two, three, and four-input types as shown in Fig. 2. In the gates shown in Fig. 1 and 2, a + 1 volt input to any input will saturate a transistor and pull the output down from the +3.5V supply level to saturation.

One of the least expensive and most ver-

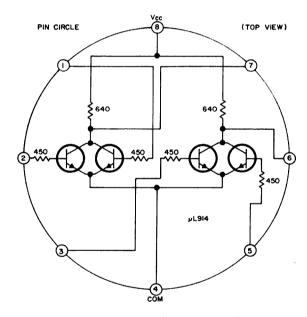
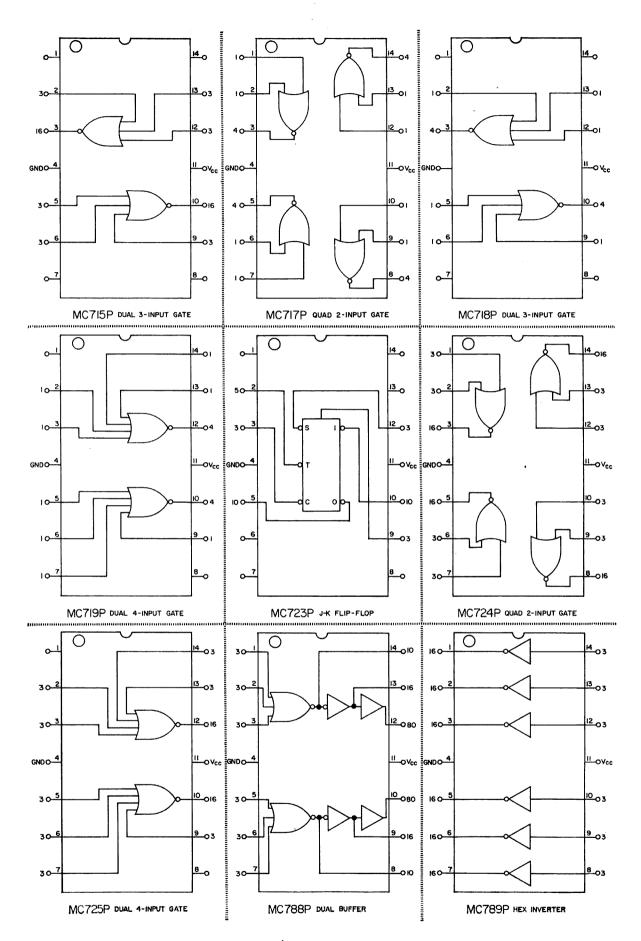


Fig. 3. Basing diagram and circuit of the Fairchild $\mu \text{L914 RTL}$ gate.

HEP Number	MC- Number	Description	Amateur Use (other than logic)	
553	303	Half-adder		
554	304	Bias-driver	Regulator	
556	306	Three-input gate	Schmitt trigger, free running multivibrator amplifier	
558	308	J-K flip-flop	Divider, one-shot multivibrator	

Table 2. Comparison of the Motorola HEP line totheir MC300 IC elements.



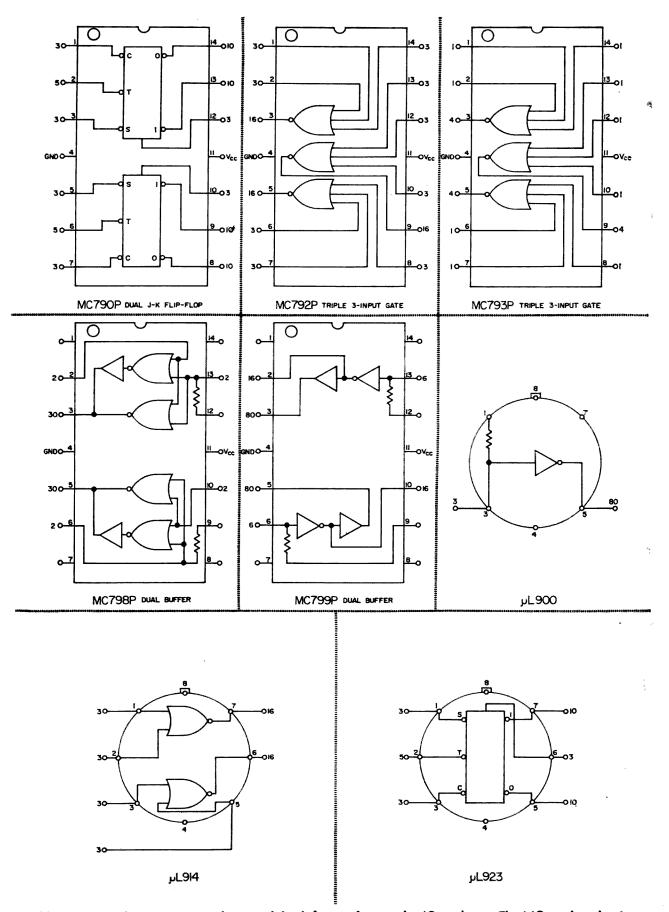


Table 1. Basing diagrams, circuit logic and load factors for popular IC packages. The MC-numbered units are manufactured by Motorola; μL-units by Fairchild.

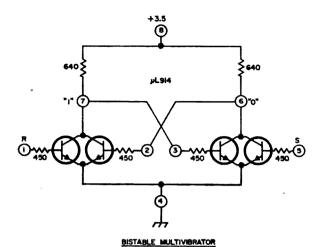


Fig. 5. A Fairchild μ L914 in a bistable multivibrator circuit.

satile RTL gates that is in general use is the Fairchild μ L914. This is shown in Fig. 3, It can be used (in addition to its normal use as a gate) as a monostable, bistable, or astable multivibrator. The bistable multivibrator connection of this chip can be purchased as the μ L902, a type "RS" flip-flop. The connection of the μ L914 in various types of multivibrator circuits is shown in Fig. 4, 5 and 6.

Although the μ L914 is easily used as a type "RS" flip-flop, it is simpler to use the μ L923 type J-K flip-flop for most purposes. The real advantage of using the J-K is the simplicity one attains in dividing by different numbers. Even fairly large prime numbers may be divided using J-K's, and no critical feedback capacitors are required. Since the J-K has many ports, there a number of ways to divide most numbers. Some examples of dividers using J-K's are shown in Fig. 7.

There are some points of care which must be observed when using these RTL IC's. The individual J-K will draw between 20 and 25 mA of current at 3.6 volts, so use good "fat" supply leads. This care in buss (and ground) lines is essential, because the RTL family has the lowest noise immunity (for spikes on the supply line) of any of the logic families. Also, when in doubt, it never hurts to put a 330 μ F-6V tantalytic capacitor right across the IC supply terminals.

The RTL J-K flip-flops require a fast risetime waveform to trigger them properly. Try to keep your rise-time to less than 1 μ sec if possible. For instance, the \div 5 circuit of Fig. 7 was unreliable when the input rise-time approached 3 μ sec.

The convention in the Motorola and Fair-

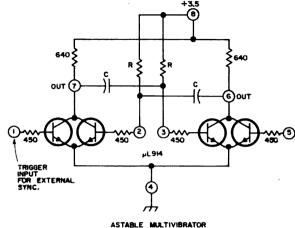


Fig. 6. An astable multivibrator using the μ L914.

child RTL family is to add load factor numbers adjacent to the pin numbers of the IC diagrams. For instance, a μ L914 gate input is *three* units of loading and a μ L914 gate output will drive 16 units of loading. This load factor scheduling is completely consis-

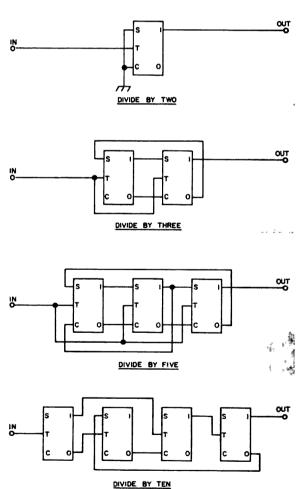
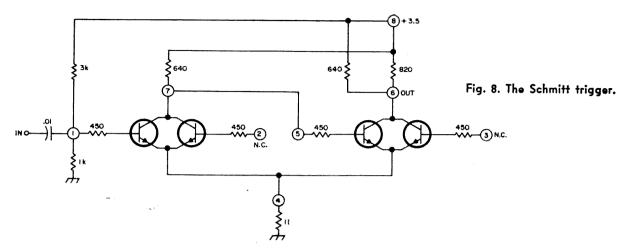


Fig. 7. J-K flip-flop divider circuits; divide by two, three, five and ten.



tent within the Fairchild μ L900 series, even though some members of this family are lower power units than others. The Motorola

MC-700P series uses the same supply voltages and logic voltage levels; and the load factor designations are also compatible with

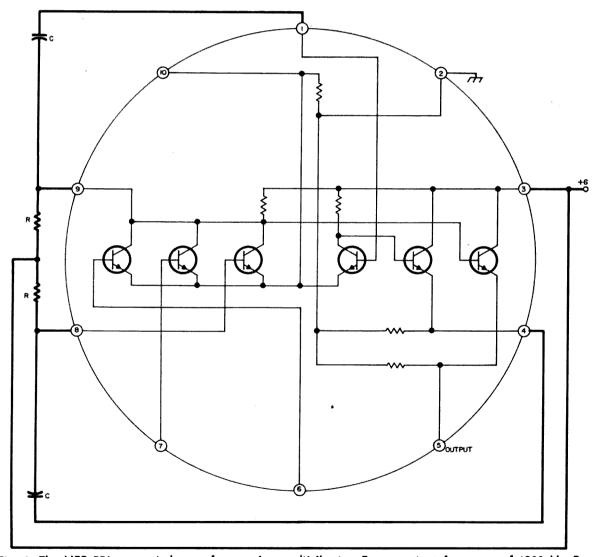


Fig. 9. The HEP 556 connected as a free-running multivibrator. For an output frequency of 1200 Hz, R = 100k and C = 0.01 uF. For greater output level at the expense of waveform distortion, pins number 2 and 10 may be shorted together.

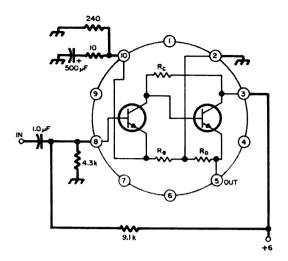


Fig. 10. Using the HEP556 as a low input impedance, low-level amplifier. The voltage gain of this circuit is approximately 20.

the Fairchild µL900 family.

The only types of RTL IC's that will appeal to those with low budget projects will be the less-expensive units that are packaged in epoxy or plastic. Three of the Fairchild μ L900 family are available in epoxy: the μ L900, μ L914, and μ L923. Also the entire Motorola MC700P family is plastic and available at about the same price level *per logic function* as the Fairchild μ L900 series.

The Motorola MC700P line includes only one single function unit, the MC723P—a J-K flip-flop. The rest of this DIP family consists of multiple function units. The MC790P is an outstanding one; it is a dual J-K flip-flop at \$2.00. This brings the price per J-K down to \$1.00, the lowest in the industry to this author's knowledge.

Table 1 shows the various economy-plastic RTL units available from the two lines discussed, with their loading diagrams and prices. It is important to keep in mind that the pin-numbering of these IC's is as viewed from the top of the package; this is the reverse of the way transistor basing diagrams are usually shown. There are several articles available on these RTL units that can be helpful: references 3, 4, and 5.

Without sounding biased in favor of RTL, the author feels that this family represents the best one to "cut one's teeth" on. The reasons for this feeling are simple: (1) RTL is inexpensive, so first experience comes cheap, and (2) since there is a resistor in nearly every lead to the internal transistors of the IC chip, your mistakes are not likely to destroy the units.

ECL (Emitter-Coupled Logic) is another

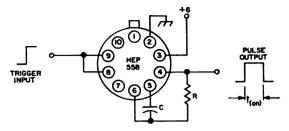


Fig. 11. The HEP558 connected as a one-shot multivibrator. The main consideration when using this circuit is to keep the value of R less than 160 kilohms; the t_(on) time will be approximately equal to 1.4 RC.

family that should be of interest to the amateur. Motorola has recently made four types of MECL (Motorola Emitter Coupled Logic) available in their HEP line. This HEP line has the distinct advantage of being available nearly anywhere in the U.S. and also through mail order firms such as Allied Electronics. Table II shows the types of HEP IC's that are available, and the similar industrial versions of each. The HEP versions of the standard Motorola MC300 series are not obliged to have the same specifications as their industrial versions, but the cross-referencing is still helpful. By consulting the Motorola Application Notes for the MC303, MC304, MC306, and MC308, a large body of helpful information can be gleaned on uses for HEP553. HEP554. HEP556. HEP558.6, 7, 8

The MECL family is unlike most other logic families in that a logic level change does not cause any component transistors to saturate. This means that the MECL family can operate much faster than others, since no saturated transistors have to be pulled out of saturation during switching. The in-

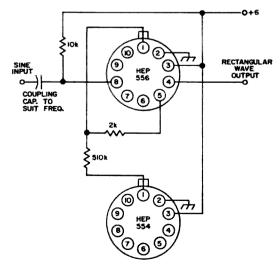


Fig. 12. Using the HEP554 and HEP556 as a Schmitt trigger. The 510k resistor should be 510 ohms.

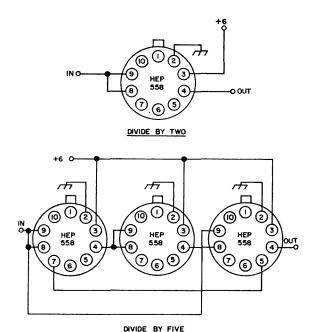


Fig. 13. Connecting the HEP558 IC as a dividerdivide by two and divide by five.

dustrial MC300 units can be used up to 30 MHz switching rates, so, we can expect to find some of the HEP units that will approach this rate, too. This inherently faster operation is reflected in small propagation

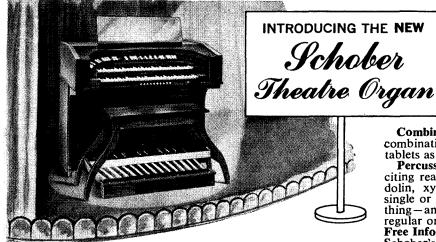
time through counting elements. This allows us to build serial dividers of large prime numbers, like 17, at fairly high frequencies.9

Fig. 9 through 13 show several uses for the HEP integrated circuits. The applications to which these circuits are put, will be left to the readers' needs and ingenuity. Some of the units which can be built using HEP integrated circuits are described in detail in a booklet by Motorola. 10

W6GXN

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Proportional Transistor Control of AC Circuits

Proportional de control of ac circuits has been one of the sticky problems in electronics since the days of the slop-jar rectifier and the "Edison" storage B battery. Most of the successful circuits take the form of a good amplifier, in which the gain in varied by the de control voltage. Until recently, this was an effective, but highly uneconomical, control method, and was usually limited to low powers.

Since the end of WW II, the situation has been improved by magnetic amplifiers, thyristors, and "back-to-back" configurations of transistors. All of these systems work, and some work very well, but their cost and bulk, not to mention procurement difficulties and delays, usually confine them to large-scale industrial and governmental use.

Relatively recent commercial availability of high-voltage transistors and of silicon bridge rectifiers of high current capacity has simplified high power rectification and control greatly, and has reduced prices enormously. A bit of cogitation, followed by some experiments, indicates that proportional control of any ac circuit by a small de control voltage, using only rectifiers and transistors, in a simple configuration, is entirely possible.

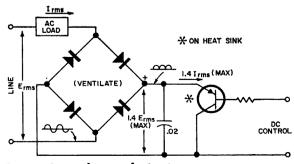


Fig. 1. General control circuit.

General control circuit

Circuit for controlling any ac load by means of a dc control voltage, using only a bridge rectifier and a transistor, is shown in schematic form in Fig. I, with approximate voltage and current values.

In this circuit, everything to the left of the bridge is ac, from the line or other source. Everything to the right of the bridge is pulsating dc, resulting from the full wave rectification of the line power. With the bridge output shorted, current through the ac load is determined by the line voltage and the load reactance (less the very small losses in the bridge). With the bridge output open, voltage across the bridge output is approximately 1.414 times the line RMS voltage.

If a variable resistor is connected across the bridge output, the current through the load can be varied by varying the resistor. If the resistor is replaced by a suitable transistor (note voltage and current relations in Fig. 1), current in the ac load can be varied by varying the dc bias on the transistor. This current is at maximum when the transistor is saturated, at minimum when the transistor is cut off, and at various intermediate values determined by base bias when the transistor is between saturation and cutoff. With a single control transistor, controlled power is from 30 to 50 times controlling power. With a Darlington pair in the control position, control ratios of considerably better than 1,000 to 1 are easily obtained.

Specific circuit data

Using standard and easily-obtained parts, a specific circuit, much like the general circuit of Fig. 1, was constructed and tested.

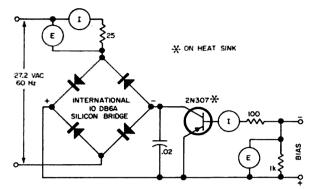


Fig. 2. Specific test circuit, with constants.

Results with this circuit, shown in Fig. 2, are tabulated in Table I. Note that in this circuit, polarity of both the bridge and of the transistor have been reversed, so that, in event of failure of the bias source, the load is deenergized.

As will be noted from Table I, performance of the circuit is smooth, there being no serious "boobles" in the control characteristic. It is quite important that the transistor have an adequate heat sink, or its characteristics will change with use-usually not for the better, A 4" x 4" by 1/16" sheet of copper, exposed to free air circulation, was found adequate for the 2N307 here used. The small capacitor shunted across the bridge is a hash filter. Its value depends in part upon the characteristics of the load, and may be anything from .01 to .1 µF per ampere of current without impairing circuit operation.

Extension to higher power

The test circuit shown in Fig. 2 has a power handling capability of 25 volt-amperes. Theoretically, the same circuit can be used for any power by suitable choice of bridge rectifier and transistor. In practice, we are now limited to about 400 volt-amperes because of the limitations of available transistors, the upper limit being attainable with the Delco DTS 423 transistors. By using an elevated line voltage, (above 115), we can squeeze out some more volt-amperes. Watch out for polarity when changing transistor types.

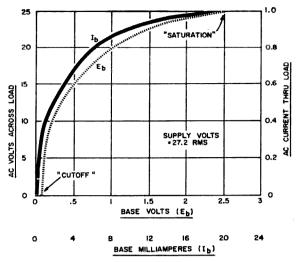


Table I. Performance of the circuit shown in Fig. 2.

When the new 10 and 20 ampere highvoltage transistors, now reportedly being developed by at least three manufacturers, appear on the market, we will be able to control more than 2,000 volt-amperes of ac by means of a relatively small dc control power.

Applications

This control circuit is an excellent replacement for a Variac within the presently-existing power limitations. As the control power is low voltage low current dv, the main elements (rectifier and transistor) can be placed near the load, and the control element, such as an Ohmite AB pot, mounted at any convenient place on the panel.

This circuit permits convenient primary control of power supplies, either manual or automatic, and has a number of possible protective applications, such as shutting off plate power when bias voltage fails.

Life of components, when properly cooled, is problematical, but very long. Silicon bridge rectifiers have service lives measurable in years (5 or more); and modern power transistors, either germanium or silicon, seem to be equally dependable.

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Phone Patching-More Light in a Gray Area

Litigation presently in the courts may clear up the legalities of phone patches.

More than seven years ago, an eloquent plea for legalizing amateur radio phone patches was made by Mr. C. D. Ehinger, a ham, K9IVY, and also a prominent member of the telephone industry, in an article which appeared in the December, 1959 issue of *Electronics World*. The article was symptomatic of the controversy that has surrounded the "gray area" of amateur radio phone patching for years and which, at last, appears headed for legal resolution.

A phone patch is, in essence, a device which interconnects the facilities of the telephone company with a two-way radio system. Tariffs filed with the Federal Communications Commission by AT&T and other telephone companies prohibit such interconnections unless the equipment, with a few exceptions, is provided by the telephone company. From the telephone company viewpoint, this restriction is necessary to prevent possible interference to telephone service resulting from the direct or indirect connection of a "foreign attachment" to a telephone line. This viewpoint is defended on the basis of the responsibility of the telephone company to provide dependable land-line communications under federal regulation in return for being granted a monopoly for telephone service in a certain area.

Over a year ago, the Carter Electronics Corp., of Dallas, a manufacturer of a phone patch device called *Carterfone*, filed an antitrust suit against AT&T, Southwestern Bell, and General Telephone Company of the Southwest. Carter Electronics seeks compen-

sation for damages resulting from an alleged loss of business due to threats by the defendant telephone companies to discontinue service to individuals and firms using the Carterfone. The courts, before handing down a decision in the Carterfone case, have asked the FCC to resolve the question of the "justness, reasonableness, validity, and effect" of the current tariff regulation. Thus, the FCC, which has in the past indicated that phone patches do not violate FCC radio service rules but has avoided the issue of the validity of the telephone company tariffs, must now come to grips with the problem. A hearing before an FCC examiner is scheduled within the next few months.

The arguments in favor of legalizing phone patches are reasonable and persuasive. From the predominant commercial viewpoint, properly designed and effective phone patches can be produced at prices well below the usually prohibitive cost of telephone company equipment offered to provide a similar service. The installation of such phone patches result in more efficient and increased use of telephone facilities. In the non-commercial area of amateur radio, if phone patches were

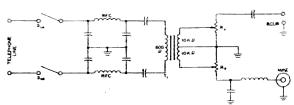


Fig. 1. Typical "home-brewed" phone patch which was widely used with AM transmitters.

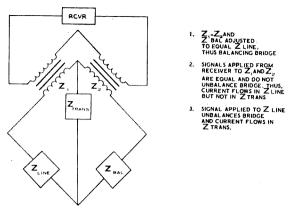


Fig. 2. The Wheatstone bridge is the basis for modern hybrid phone patch circuits employed with VOX operated SSB transmitters.

to be removed from the "gray area", a marked increase in public service phonepatch traffic, particularly with overseas military personnel, would ensue. Telephone companies have in the past indirectly indicated the usefulness of the phone patch by turning their heads the other way concerning amateur radio use of these devices. Nevertheless, the "gray market" has forced all but two amateur radio equipment manufacturers, Heath Company and Waters Manufacturing Company, out of the ham phone patch business. Heath Company reports that despite the "gray area" and to the best of their knowledge, their patch has never been the cause for a complaint by a telephone company against a user. Adequate performance and low-cost therefore appear to be compatible in today's phone patch designs.

Adequate performance was not always the case with amateur radio phone patches. The type of patch illustrated schematically in Fig. 1 was considered fairly sophisticated fifteen years ago but provided what could be termed only satisfactory performance with AM rigs at that time. This design employed

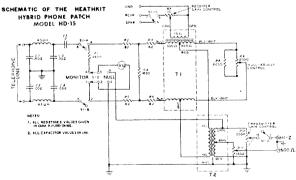


Fig. 3. A typical hybrid phone patch design using special transformers for optimum energy transfer and impedance matching.

an audio output-to-line transformer which at least approximated a match to the telephone line impedance. The center-tapped high impedance winding helped reduce hum pickup which was a real problem in early home-brew patches. Most of us can also recall phone patch circuits which employed power transformers in crude designs which were matched by equally crude performance. One can only imagine the detrimental effect these devices had on telephone service. The circuit in Fig. 1 was, with its attention to impedance matching, hum reduction, and rf filtering and bypassing, at least a step in the right direction.

With the increased popularity of SSB by the early sixties, phone patch design was forced to take a giant step forward to satisfy the demand for patch operation consistent with the VOX capability found on most all SSB transmitters. To eliminate the need for manual transit-receive switching during phone patch operation with VOX equipped SSB rigs, true telephone-type hybrid circuitry was required in patch designs. Thus, more accurate telephone line impedance matching was a necessity and telephone quality transformers were employed. Also about this time. the need for monitoring the input level to the telephone line was realized and VU meters, as employed by the telephone industry, became standard equipment on most hybrid phone patches.

The operation of a hybrid phone patch can best be understood by referring to Fig. 2. The basic requirement of the circuit is to passively couple audio from the receiver into the telephone line without energy being delivered to the transmitter audio input at a level which will cause the VOX circuit to operate. As described in Fig. 2, our old friend, the Wheatstone bridge, provides an effective means of satisfying the basic patch requirement outlined above.

A practical embodiment of this circuit is illustrated in the hybrid phone patch design presented in Fig. 3. In addition to the normal hybrid circuit components, on-off switching functions and appropriate rf filtering, several other significant circuit techniques are evident here. A 600 ohm resistive H pad is provided to isolate the telephone line impedance, which can vary from installation to installation, so that a simple balance network can provide maximum transmit-receive isolation at every installation. The VU meter can be switched from its normal line level



Fig. 4. The Heath HD-15 Hybrid Phone Patch employs a VU meter for monitoring input level to the telephone line and indicating correct null adjustment.

monitoring function to a null indicating function to permit accurate adjustment of the balance, or null, control. A strong heterodyne is tuned in on the receiver and, with the patch on and a telephone call actually placed, the balance control is adjusted for a null on the VU meter which is measuring the voltage developed across the transmitter input level control. Once set, the balance control usually needs no further adjustment. Notice also that this patch design also employs transformers which match the impedance of the receiver output and transmitter input as well as those of the telephone line to provide maximum overall energy transfer.

Mr. Ehinger's 1959 article suggested several requirements for the design and use of legal phone patches. These were use only with radio equipment and by operators having valid FCC licenses, use only on a private telephone line, location of the telephone at the radio operating position, patch provision for monitoring input level to the telephone line, and payment of a nominal, monthly fee to the telephone company. All requirements, except the last, still seem to be reasonable. If the tariff is revised to permit phone patching, it does not appear that the telephone companies would be justified in charging a fee for use of equipment that belongs to an individual. Phone patches supplied by the telephone company, should they be made available, would be a different matter.

Whatever the outcome of the *Carterfone* litigation, it is encouraging that the question of phone patch legality is finally being scrutinized. At least it indicates that there is a growing interest in legalizing phone patches and that a demand exists for reasonably priced phone patch equipment. Let's hope a decision favorable to hams will be handed down and result in complete illumination of the "gray area". . . . K8BLL

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WTW Report

WTW is picking up faster all the time now. If the requests for our new WTW country list/tally sheets are any indication, things will be rolling in high gear for sure in a few months from now. I have been sending out these sheets at the rate of six a day. It seems as if many fellows are interested in WTW—a lot more than I ever thought.

The new WTW country list/tally sheets consist of four pages printed on both sides. Spaces have been allowed so that you can use them for ten years. About every fifth line has been left blank for additions as they turn up or corrections as they are discovered. I will take full blame for the various mistakes that are on these sheets-they were laid out, made up and printed by me so these mistakes cannot be blamed on anyone other than myself. They are free for the asking provided you send along a manila envelope (9 by 14 inches or larger) self addressed and with 10c worth of stamps on it. This will pay the postage for 3 or 4 sets of these forms depending upon the weight of the envelope. One set of these forms must be filled out and sent in with your first batch of cards. We retain this form and file it away to add the countries as you send them in to us. One form is required for each mode on each band. This may seem like a lot of work but later on it will simplify our task of keeping the records straight. This will be especially true when the 5 year period has passed and you begin to lose the countries you worked 5 years ago.

If you are considering trying for WTW, by all means get yourself a set of these forms. It will make your record keeping a lot easier I am sure. A complete list of WTW countries is included so you know what counts and what doesn't. A few of them may surprise you if you have not seen our list recently. Send along a large envelope for your copies and it will be sent out pronto.

We have received many suggestions from different DXers regarding WTW. At this moment we have not decided what changes, if any, will take place. Right now we are "mulling over" the idea of accepting cards in multiples of less than 100. This would keep everyone informed as to how others are doing in their WTW work.

There will be a column in each issue of 73 from now on that's devoted to the progress of WTW. We think it will be of interest to all DXers because competition will become keener as more fellows qualify. The day may come when we will keep a running record of the top 10 or 20 or even 30 who are battling it out for top position. I have had many letters suggesting this and it seems that this would make things more interesting to the fellows. What do you think Mr. DXer?

At this time we still need a DX Club to check WSL cards for these call areas: W/K 1, W/K 2, W/K 5, W/K 8, and W/K Ø. We need one or two such check points for Africa, one in the southern part and one in the north. Two are still needed in Asia too—one around Hong Kong or Japan and the other somewhere around western India, Tehran or thereabouts.

Do we have any volunteers for these check points? We furnish the necessary blanks needed for proper record-keeping. We want every checkpoint to use the same kind of record keeping so that we will have a uniform system. The work involved is not too great, at least not at this time, but we hope it will grow as WTW interest grows.

The address of each of the current WTW QSL check points is as follows:

W/K 3-Western Pennsylvania DX Society, John F. Wojkiewicz W3GJY, 1400 Chaplin Street, Conway, Pennsylvania 15027.

W/K 4—The Virginia Century Club, P.O. Box 5565, Virginia Beach, Virginia 23455.

W/K 6-Orange County DX Club, James N. Chavarria, 3311 Stearns Drive, Orange, California 92666.

W/K 7-Western Washington DX Club, Inc., William H. Bennitt W7PHO, 18549 Normandy, Seattle, Washington 98166.

W/K 9—The Montgomery County Amateur Radio Club, Scott Millick K9PPX, Litchfield, Illinois 62056.

Canada—The Edmonton DX Club (VE6GX), 12907 136th Avenue, Edmonton, Alberta, Canada.

Oceania—The New Zealand Association of Radio Transmitters, Jock White ZL2GX, Contest and Awards Manager, 152 Lytton Road, Gisborne, New Zealand.

South America—Venezuela Amateur Radio Club, P. O. Box 2285, Attention of YV5CHO DX Committee, Caracas, Venezuela, South America.

Europe-Via R.S.G.B.

Hawaiian amateurs send their cards to the W6 check point.

All others send your cards to: Gus M. Browning, Route 1, Box 161-A, Cordova, South Carolina 29039.

Each group of cards sent to any check point must be accompanied with a remittance of \$1.00 to cover costs of certificates and handling—plus postage to cover the return of your cards. Please specify method of shipment and enclose a large addressed envelope. Otherwise your cards will be returned to you via third class mail.

Notice that W5KUC, W4NJF and W3DJZ have qualified for the 200 country certificate for 14 MHz phone. Mind you, these fellows have worked and received QSL cards from 200 countries in less than one year. As you know, WTW only started at 0001 GMT Mav 1st last year. This should prove to you that it's possible if you make up your mind that you are going all out. I bet these fellows had a ball working DX all over again. I know these fellows and they are the type who get things done when they make up their mind to do it. We wish to congratulate them on a job well done. They are presently working hard on their WTW-300-WOW-I sure hope they make it. That's it for this month. If you have any questions please write me and I will try to answer. Please send along a sase. Thanks.

. . . Gus

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What's New for You?

This column is set aside for short technical notes, comments on 73 articles, information about new and useful components and surplus, and announcements about technical nets and technical clubs. If you've come across something that you think would interest 73 readers, but don't think it's worth a full article, send it along. We'll give you credit in the column. Send your contributions to Paul Franson, 38 Heritage Road, Acton, Massachusetts 01720.

Don't forget that we're looking for a new name for the column, a name that fits the content a bit better than the present one. I've heard two suggestions so far, but I'm not sure whether they're serious: Technical Trash, and Electronic Eclecticism.

New FET's

There are several new field effect transistors on the market which should appeal to the amateur experimenter. The most exciting of these is probably the 2N4416 from Union Carbide. This device is still somewhat expensive (about \$6.00), but displays excellent noise characteristics on 144 and up. Preamplifiers built for 432 MHz with the 2N4416 for example, exhibit noise figures on the order of 2.5 dB: gain is 12 dB. On 144 the noise figure is about 2 dB with 18 dB gain. Next month 73 will have a construction article using this FET in both 144 and 432 preamplifiers.

A low cost plastic encapsulated FET which looks quite interesting is the new Motorola MPF-102. This transistor is designed for VHF amplifier and mixer applications and features guaranteed parameters at 100 MHz. Forward transconductance at 100 MHz is 1600 μmhos minimum. The input capacitance is 7 pF and the reverse transfer capacitance is 3 pF. Maximum drain-source voltage is 25 volts.

73 Transistor Circuits

Trouble with FET diagrams again! In WIDTY's article in the March issue there are several errors in the schematics using field effect transistors. The thing to remember here is that the N-channel FET requires a positive drain supply, the P-channel FET, a negative supply. P-channel FET's include the 2N2607, 2N4360, TIM12 and U112. N-channel types are the 2N2943, 2N3819, 2N3820, HEP-01, MPF-103, -104, -105 and TIS34.

Diagrams to watch in the circuits article are Fig. 11, 17, 39, 40, 47 and 71.

Transconductance Tester Troubles

WA4UZS reports that he had a little trouble with transients in the FET Transconductance Tester he built from WIDTY's article in the January 73, but cured it with a 0.047 μ F capacitor across each of the push button switch contacts.

I-177B Schematic

A manual, schematic and updating information for the I-177B tube tester is available from the Engineering Department, Daven Division of the Thomas A. Edison Industries, Grenier Field, Manchester, N.H. 03103 for \$2.50, reports W1DKG.

Slide Rule Error

The conversion of pi/2 radians in the article on slide rules in the March issue is wrong. It should be 90° instead of 1.57°. If you put 2 on the C scale over pi on the D scale, the answer is read on the D scale under R on the C scale. The basic formula for these conversions is pi \times R =180, where R stands for 1 radian. Thanks to WA8LQS for this.

Product Detector Circuit Board

The connections on the right side of the circuit board on page 34 of the March 73 are reversed. The board is for a solid-state product detector. Gregory Perreault of Glen Rock, N.J. caught this one.

RTTY Translator Error

There is an error in the schematic of the RTTY encoder on page 37 of the January issue. The 0.033 and 0.038 μ F capacitors in the frequency-determining network are reversed. The component reference numbers were also omitted from the schematics and pictorials, but not the text, causing some confusion. On page 35, R1 and R2 are the $6.8k\Omega$ resistors in the emitters of Q2 and Q3. R12 on that page is the resistor shown in series with the magnet. On page 37, reference is made to an R10 and R12 in the encoder circuit. These two resistors are the 100 k Ω and 6.8 Ω resistors attached to the base of Q4. The author of the article, W6AYZ, sent us these notes.

. . . Paul

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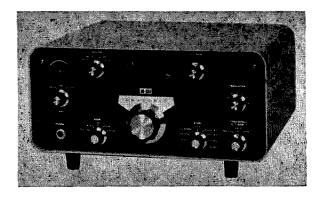


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Mort Waters W2JDL 82 Boston Avenue Massapequa, L. I., N. Y.

The Heathkit SB301 Receiver

The Heathkit SB301 is an updated and improved version of the older SB300 which, in its short history has already earned a welldeserved niche in ham radio. The 301 is a ham-bands-only SSB/AM/CW/RTTY receiver with coverage from 3.5 MHz through 30 MHz, easily extendable to the 2- and 6-meter bands with accessory converters, both of which mount neatly on the receiver's rear apron. A front panel switch concentric with the rf gain control selects either converter and simultaneously switches the input of the receiver from the normal antenna to the converter outputs on 10 meters. Frequency coverage with the converter crystals supplied is from 144 to 146 MHz and 50 to 52 MHzthe tuning range can be increased with accessory crystals.

Power for the converters flows only to the converter which is selected by the panel switch mentioned before. When the receiver is operated on the low bands, no voltages reach the converters.

CIRCUITRY

The incoming signal is amplified by a 6BZ6, the rf stage and capacitance coupled to the grid of the first mixer, a 6AU6, which receives the local oscillator signal from the crystal-controlled 6AB4 heterodyne oscillator. The latter's coils have a small pickup winding which feeds the oscillator output to a jack on the rear apron, where it is available for transceiving with the matching transmitter, the SB401.

The 6AU6 mixer stage mixes the signals, with the sum and difference frequencies being applied to a bandpass coupler having a passband from 8.359 to 8.895 MHz. Emerging from the coupler, the wanted signal is then applied to the grid of the second mixer, an-

other 6AU6. At the same time, the 5.0 to 5.5 MHz output of the LMO is coupled to its cathode. For transceiving, the LMO output is also fed to a jack, through a .01 capacitor.

The second mixer's output at the *if* frequency of 3.395 MHz passes through a crystal filter to the *if* stages (you get one filter with 2.1 kHz bandwidth with the kit; AM and CW filters are available as extra cost accessories).

The *if* amplifiers, 6BA6's are both high gain voltage amplifiers, tuned for maximum gain. The S-meter is connected between the screen of the first *if* and the cathode of the second, with a chassis-mounted zero-adjust potentiometer providing precise settings.

A new feature of the SB301 that didn't appear in the 300 is a self-biasing, full-wave, shunt-type noise limiter which automatically adjusts itself to the degree of modulation of the incoming signal. This system has the advantage of moving the point where limiting begins up and down along with the signal level. The limiter is either in or out of the circuit, depending on a push-pull switch integral with the AF gain control. The degree of limiting cannot be controlled manually. The system operates in all modes and performs effectively.

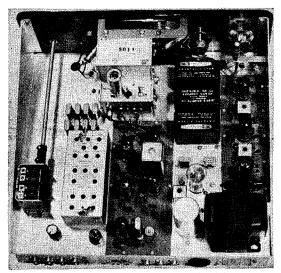
AGC voltage is obtained by rectifying a portion of the *if* output signal, then passing it through a capacitor-resistor network which applies the voltage to bias the rf amplifier and the *if* amplifiers. This system is of the instantaneous attack type; one of two decay "speeds" is switch selected—slow for SSB, fast for CW and AM. An "off" position is also provided for maximum gain when digging for the weak ones.

A three-section Compactron, a 6AS11, combines the product detector, BFO, and BFO amplifier in one envelope. The BFO oscillates at one of three crystal-controlled frequencies, selected by the mode switch. In the RTTY position, the crystal frequency is 3392.110 kHz, placing the detected signals of 2125 and 2975 kHz in the center of the band pass frequency range of the SSB crystal filter. Narrow band RTTY operation can be had in the CW position of the mode switch. If you're operating SSB and want to change sidebands, here's what happens: the crystal that is switched into the circuit increases the BFO's operating frequency by 2.8 kHz. At the same time, the LMO is automatically shifted 2.8 kHz lower by a diode switch so you've changed sidebands without having to move the dial-you continue to read frequency right off it.

The mixed if and BFO frequencies obtained from the product detector are capacitor-coupled to the grid of the first audio stage, one-half of a 6HF8, which drives the second audio; either high impedance headphones or 8-ohm speaker operation is available. Negative feedback from the output transformer to the cathode of the first audio stage provides low distortion audio.

For AM reception, the BFO is switched off and the *if* output is coupled to a diode detector instead of the product detector and thence to the audio stages.

The lineup is completed by a 100 kHz calibrator that can be zeroed against WWV's



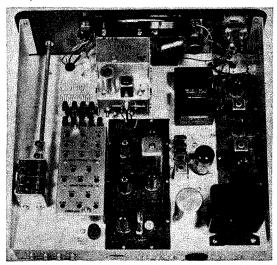
15 MHz signal. The band switch has a special position for receiving WWV—another new and welcome feature that was missing from the 300.

Assembly

No unusual problems were encountered in building the receiver except one of my own making. I did not observe the cardinal rule of kit building-read the instructions first, and follow them exactly. In blind confidence, I unpacked all the parts and sorted them out, but when I began to check them off against the parts list, I discovered that Heath had made another important advance. There were separate numbered "parts packages" that were called for individually as you begin each stage of assembly. The advantage is, of course, that you don't have a lot of small parts floating around long before you need them. Had I read the manual carefully I would have known this. Take warning, do as I say, and not as I do!

Total assembly time was about 24 hours, and alignment with the built-in crystal calibrator and S-meter went very rapidly. Not a single operating difficulty was found, a testimony to the good design, careful engineering and superb manual that makes it possible for anyone who can solder to build this kit successfully.

In case of difficulty, extensive trouble shooting procedures are carefully outlined in the manual, and complete voltage and resistance charts are included. According to Heath, 90% of the troubles that do arise



This bird's eye view shows several differences between the SB300 and SB301. The SB301 on the right has an additional heterodyne oscillator crystal and coil—immediately to the left of the large board. The converter switch which was located on top of the chassis in the SB300 is now located on the front panel. The three crystal filters of the 301 are somewhat smaller; the 6AS11 Compactron (below crystal filters) has been moved a little and is now adjacent to three crystals instead of the two that were used in the SB300.

are traced to poor soldering, so check that first.

Comparing the SB301 to the SB300

Owners of the older model will be interested in the differences between the two; physical changes are quickly apparent. On the front panel, the function switch and the AF gain control have been moved nearer the top. The AF gain knob also pulls out to turn on the ANL. The mode switch now has RTTY position and the band switch, its opposite number in location, includes the WWV 15 MHz position. At the bottom of the panel the converter switch is concentric with the rf gain control. It was formerly located on the top of the chassis and you had to open the lid to get at it.

Examine the top view photos of the two receivers; the holes in the coil cover indicate two things—coil locations have been shifted and an additional heterodyne oscillator coil appears. It is, of course, for the 15 MHz WWV position.

Three crystals appear in the chassis area of the 301 forward of the power transformer, where the 300 had only two. The extra one is for RTTY reception. Further forward in the same area, the three crystal filters are

located. The new ones are not only smaller—but better. The 400 Hertz CW filter is now only 2 kHz wide 60 dB down, compared with 2.5 kHz in the old one.

The VFO in the receiver, which Heath calls the LMO (linear master oscillator), is a slightly modified version of the original model. An industrial grade 6BZ6 has been substituted for the original 6AU6, and there are some minor changes in the values of one or two parts. Its stability is excellent; drift is completely unnoticeable from a cold start.

Operation

One of this receiver's outstanding characteristics is its quiet operation, but don't make the mistake of thinking this means it's dead. Far from it—it's got sensitivity to spare. Tuning is smooth and the degree of tension on the dial is adjustable to your own tastes. With the receiver properly calibrated, frequency readout and resetability are outstanding, within a fraction of a kilohertz.

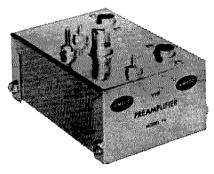
When you wrap the whole works up in the neat two-tone green cabinet Heath favors, you've got a receiver that's an impressive package for the money.

. . . W2JDL



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78 73 MAGAZINE

Face-Lifting the TS 34 | AP Oscilloscope

The TS 34/AP Oscilloscope is one of the best buys on the surplus market today but, due to its World War II vintage, it is sometimes by-passed for other equipment. When you look at a TS 34/AP it reminds you of the old kaleidiscopes found in penny arcades at amusement parks-the kind you squint into to see the girlie pictures. The TS 34/AP is something on that order but a face lifting will make it look like a million dollars.

This oscilloscope is a real fine instrument and has many excellent operating characteristics. It's light weight and small size make it an excellent portable or fixed station scope. The TS 34/AP operates from 110 volts at 50 to 1200 Hz and draws 90 watts. The sensitivity is .1 to 100 volts and sine waves are observable from 30 Hz to 1 MHz.

The first job is to bring the 2API tube up forward. This simple modification makes better viewing of the cathode-ray tube from all angles so you don't have to squint into the scope to view the test pattern. Remove the top cover of the cabinet and take out the long black Armco-iron shield over the CRT. Save the small shield which is inside the long one. Next measure 71/8 inches in from the socket end (rear) and cut off the shield with a hack saw. This short shield will be used when the tube is moved to the front.

Next we work on the front end of the top cover to prepare it for insertion of the 2AP1 tube. The eye-shade or hood should be removed, leaving an oval hole. This hole must be enlarged to take a round meter bezel, 2 to 21/4 inches in diameter. I used a meter bezel which I found in the junk box. Prepare a new sub-panel 7 x 31/4 inches which is to be fitted over the enlarged hole. Do-ityourself aluminum was used here. Cut out the hole in the center of this panel for the bezel; fasten panel and bezel to the top

The top cover needs more surgery, so cut out a hole 10 x 5 inches right in the center. Start 234 inches from the front edge. This hole will be used later for adjusting the installation of the 2API tube. You will also need it to replace tubes. Next make a cover or lid to fit over this hole using do-it-yourself perforated aluminum and fasten it with self-tapping screws. Allow at least a one inch margin around this lid so it will be secure when fastened to the cover. When this is finished, paint the new and old parts of the

top cover with a spray-can.

Our next job is to move the 2AP1 tube forward by lengthening the wires going to the tube socket. The present socket will be moved forward about seven inches. Allow enough wire when splicing the additional wire to the original leads. To get an idea of the length of the required splices, place the 2AP1 temporarily in the bezel and measure the additional wire length to each pin of the socket. It is a good idea to lace and bind these wires together when splicing is completed. A bracket must be made to hold the shield, similar to the original bracket at the rear of the chassis. It can be made from a small piece of aluminum shaped like the letter Z. It is then fastened to the screw just in front of the 6AG7. This screw and washer hold down the phenolic tie point board. The bracket should have a nut and screw attached to it so that the little fork on the rear of the shield fits down on it and holds secure.

Now the final adjustment of the face lifting. Fasten the socket into the Armco-iron shield. Take the small shield and insert it inside the larger one. The 2AP1 tube is then pushed down through the shield until it fits into the socket. Then the tube and shields are placed through the bezel. The small fork on the outer shield is fastened to the screw and nut on the bracket. To keep the tube rigid, put a piece of rubber around the edge of the 2AP1 tube.

If you have followed these simple instructions you will have a scope of modern design and you can enjoy the capabilities of this \$1,000 instrument—that's what the government paid for it.

. . . K6GKX

Howard S. Pyle W7OE 3434 74th Avenue, S.E. Mercer Island, Washington 98040

Climbing the Novice Ladder

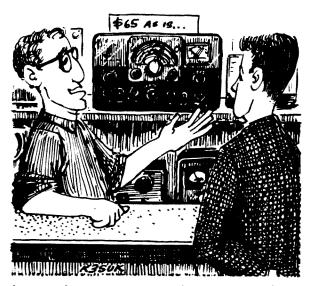
Part VII: Judy and Joe take their written exams and report on their transmitter hunt.

By the following Saturday neither FN nor Larry had received the sheets for the written portion of the novice exam for Judy and Joe from FCC but the two youngsters had not wasted any time during the week. In addition to cramming for the exam they had made the rounds of the local ham stores and accumulated some ideas for their transmitters. FN had accordingly invited them to drop out and discuss what they had found, so early that afternoon they peddled out to his shack.

Judy opened the discussion; "Gramps, we saw quite a bit of some pretty nice gear down-town but those we think we'd like to have were way out of our price class. Joe starts working at the supermarket on Saturdays right after school opens and with what he'll make there and what he has saved from his paper route, he figures he can go about \$60 for a rig. Me, I'm not quite so flush; I don't have any job prospects except occasional baby-sitting and I don't have too much left in my piggy bank . . . about \$20 is all." Joe then chimed in with "Well, I'm luckier than Judy as I already had a receiver and didn't have to buy one; what I saved there can go on the transmitter. I saw a couple of jobs I'd like to have but they're a bit complicated for me. Jim Turner has a Viking Ranger for \$65.00 but it's priced that low because the modulation section is burned out. Larry took a look at it with me and said, from the looks of it quite

a bit of work would be necessary and I'd have to buy a new modulation transformer and maybe both tubes. I'd like to have phone after I get my General ticket but Larry advised against tackling the repairs on the Ranger; what you think?"

"I think Larry is right, Joe. If the modulation section is gone it's very possible that you'll find more trouble in the rf portion. Generally, when the major portion of a transmitter goes out, it carries other things along with it and you may bite off quite a frustrating job if you go for that one.



Joe considers a Ranger in need of repair. "Dad . . .

JUNE 1967

A Ranger is a swell little job when it's operating normally but if it has been abused, it isn't exactly child's play to restore it; I believe I'd forget it if I were you. What was the other one you saw Joe?" "Well, it was a military surplus job . . . a TCS with an AC power supply and it had been modified and fixed up so it would handle 20, 40 and 80 OK . . . no 15 though. Jim was asking \$45 for it which Larry says is a good price but he wasn't too keen about it. The modifications weren't too well done and the power supply was a home-brew job and kinda sloppy although Jim said the set-up worked very well; he tried it out before he took it in on a trade. I might be getting a bag of lemons though if I bought it off the shelf".

"Neither the Ranger nor the TCS sound like very good bets to me Joe," FN replied, "I think you can do better than that. What about a new kit job? You've had enough electronic building in school so that you shouldn't run into any great amount of trouble putting one together and then you'd have something modern and new so you shouldn't experience any grief there. Did you look over the kit catalogs?" "Yes, FN, I did" Joe returned, but I just kinda thumbed through 'em . . . didn't really come up with anything: I thought I'd see what you thought about the Ranger or the TCS first". "All right, Joe; suppose you take a good look at what Heath, Knight, Eico and others have to offer. Read the dope thoroughly on each one and drop back in a few days and we'll talk about it. Now Judy, \$20 isn't going to get you much of a transmitter although if you want to, you can get a time payment deal on something pretty good." Gramps, my little income is too unstable to sign up for something maybe I couldn't pay for. I don't think Dad would want me to either; he'd have to guarantee it you know at my age" she laughed. "Joe and I are going to the club with Larry tonight though and they're going to have an auction; maybe something will turn up there for both of us . . . let's wait and see Joe, OK?". "Sure" said Joe, "another day or two won't hurt us and I'd rather get something I want than take a chance". "Good idea kids" FN put in, "sometimes these club auctions offer some pretty fair pieces of gear . . . it's worth a try". "OK Gramps, we'll take in the auction and I'll let you know tomorrow how we made out. Larry said he'd pass on anything that looked good before we went for

it" and with those parting words, Judy mounted her bike and led off with Joe following on his Honda.

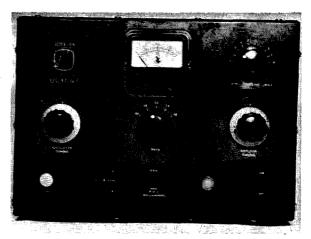
The following day Judy's family made the trek out to FN's place where they were joining the older folks for Sunday dinner. Judy immediately cornered FN and said somewhat dubiously but with obvious excitement, "Do you know Gramps, there was only one transmitter offered at the auction and it was a six and two meter transceiver; nice looking job but it was nothing for Joe and me to start our novice career with: it went for \$85 to the highest bidder which was out of our class anyway. "But" and Judy glowed but still looked a bit dubious, "one of the hams at the club told me that he just got the latest "Blue Book" listing of re-conditioned equipment from World Radio Labs and as there was nothing that he wanted this time, he gave it to me as it had several nice little transmitters on it. I brought it along Gramps; there's one that sounds pretty good to me but it's \$35. Dad said though that if you approved it, he would give me the other \$15 I'd need, for a birthday present . . . I'll be 17 Wednesday you know!" "Let's have a look Judy; maybe you've hit a jack-pot; WRL generally have a pretty good assortment and you can't go wrong dealing with them . . they're good people. Ah, theres' seven transmitters on here: four of those you could use . . . the others' are kinda in the money; which one were you thinking of?". I kinda like that little Viking Adventurer; Larry had one once and said it's a dandy little rig and an FB novice transmitter; has all of the bands and is crystal controlled . . runs about 50 watts. Larry gave me a catalog sheet on it and I read it over . . here it is . . what do you think of it?" "Judy, maybe you have hit a jackpot here. As I remember, those little jobs cost about \$65 or \$70 as an unassembled kit and WRL is offering it completely wired. reconditioned and tested for \$35. Not bad ... not bad at all. Let me read this description sheet to refresh my memory; I knew these little rigs once but some of the details escape me now. Uh, huh, crystal control for your novice start and when you get to be a General you can build or buy a VFO to plug into it; fine. Also, if you want to take a crack at radiophone, a simple little modulator is not hard to build for a rig of this power. The circuit is conventional, the keying is clean and it has band switching . . . no

plug-in coils to monkey with. Here's something too that I bet you overlooked on WRL's list; your Dad won't have to put up as much dough as he thinks . . you get a 10% discount if you don't offer a trade-in to partly pay for it; costs you only \$31.50 that way!" "Gee Gramps, I did miss that . . it sounds better yet . . what do you say?" FN took a couple of deep drags on his pipe, removed it from his mouth and said, "OK Judy; I'll give you a green light on that one; don't see how you can go wrong. I'd move fast though for someone may snap it up if you delay. If WRL pronounces it OK, thats' good enough for me and they're not very far from here . . just over in Iowa . . so your parcel post cost won't be very great. Let's talk to your Dad now".

Bubbling over with excitement, Judy shouted to her Father, "Wait up Dad; we've got something to talk to you about". Tom Mansfield, who was examining a new colt in the corral, turned and smiled as he saw Judy's eager approach. "I know." he said, "and I'll bet it'll cost me money". "Remember Dad, you said you'd pay off what I needed if FN said I should get that transmitter. Well he did and it's not going to cost you so much either; we get 10% off as long as we don't have anything to trade in on it". Laughingly Tom turned to FN and



we've got something to talk to you about . . ."



The neat little re-conditioned transmitter which Judy chose for her initial station.

said, "I knew you'd scheme between the two of you to take me to the cleaners but I'm a man o' my word you know. You think it's OK for her to buy this little transmitter then, eh FN?" "Yes, Tom", his Dad replied, "it's a good little rig made by a well-known and reliable manufacturer and offered by an equally reliable mail order firm. It's really a good buy and I'd say go for it. "OK" replied Tom, "we'll make out an order tonight Judy and I'll mail it in town first thing in the morning." With stars in her eyes Judy exclaimed, "Well, that takes care of me; I beat Joe to it anyway . . . wonder what he'll come up with".

The morning mail brought Judy's FCC examination papers to FN and he phoned to let her know that he had received them. Naturally anxious to get her license as soon as possible Judy asked, "Gramps, would it be OK if I peddled over this afternoon and you gave me the exam?". FN chuckled, realizing her eagerness but replied, "I'm sorry Judy but I've got a man coming out to figure an irrigation deal for me this afternoon. I'll be free in the morning though and you'll be fresher; why don't you come out then?" "OK Gramps, I'll be there at 9 o'clock . . OK?". FN assured her that it was and then asked, "Do you know if Larry got Joe's papers this morning too?" "Oh yes" replied Judy, "I nearly forgot; Joe phoned and said Larry called him and said he had his papers now but he is going to examine Joe right at home this evening; Larry works weekdays you know until college starts". "Fine" said FN, "we'll each examine our own candidates separately then; you be out here in the morning and I'll put you through the hurdles." "OK Gramps, bye-bye and "73"



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VANGUARD LABS

196-23 Jamaica Ave. Hollis, N. Y. 11423 and Judy hung up.

When she arrived next morning, FN told her that Joe had called and said that Larry had examined him the previous evening. Joe hadn't found it too difficult and Larry told him that while he could not give him an official opinion it appeared to him that Joe had made the required percentage nicely and probably with some to spare; the real decision would come from FCC of course. Joe had also discussed kits with FN and seemed to have more or less settled on one and would be out the next day to talk with him about it.

FN, complying with the instructions on the examination paper envelope, opened it and passed the contents to Judy, asking her first to read the envelope instructions which were directed to the applicant and to follow them to the letter. After doing so, Judy carefully read over the questions, pondering a few of them with furrowed brow and then carefully marked off what she considered the correct answer on the formal answer sheet supplied. She had completed all of the answers in little more than half an hour while FN read the morning paper and smoked his faithful briar. Being a thorough-going youngster, Judy carefully went over all of her answers, pausing at two points to do a bit of deep thinking and then carefully and completely erasing two answers and substituting new marks. Gramps," she finally announced, "that's it: I think I've got most of them correct, at least according to the way I understand it; what now?" "That's all of it girl; the rest is up to me and the FCC. I have to sign the statement on the back, stick the whole business in the envelope you brought with you and drop it into the post-office when I go down for the mail this evening. From then on it's waiting game for you. You'll either get a notice of failure from FCC or a brand-spankin' new license and a set of call letters. Don't be in a dither though until you get word; may be in two weeks, maybe three, possibly six or eight. The FCC is efficient but remember they have lots of other divisions besides amateur and they are far from overstaffed. It is anybody's guess when you'll get the word. Don't try to rush 'em by sending an inquiry; you'll more than likely delay rather than help, whatever action they take. Just be patient: FCC has just recently mechanized their license processing which should speed up the

issues but you'll not be a licensed operator until you get that all-important little card in the mail. Meanwhile, you're waiting for your transmitter to arrive too so why don't you just go play with your dolls or make mud pies or whatever you girls do to pass time!" 'Oh Gramps, "dolls . . . mud-pies . . . what you think . . . I'm still five years old?" she laughed. "Don't worry, between Dad and Mom they'll dream up enough chores around home to keep me occupied. What do you think I did with the exam though?". "Well Judy," FN replied, "I'll give it the once-over but just as Larry told Joe, there can be nothing official about what I say . . . all I can do is express a personal opinion; the FCC will give you the answer straight across the board; just a minute now". FN then carefully ran his eyes down the question sheet mentally checking each answer as he went. In a few minutes he said, "I'm going to say that I'm pretty sure you'll make it. There were a couple of places where I think you could have done a bit better but to me it appears that you have more than an adequate number of correct answers to make the grade. We'll just seal it up now so I can mail it this evening and wash our hands of the whole biz till the magic word arrives". Judy was already atingle with hopeful anticipation as she mounted her bike and peddled swiftly homeward.

The next morning Joe appeared at FN's place ready to discuss his thoughts on a transmitter. He lost no time in announcing, "FN. I think I've found it. The more I studied



"... What do you think about it, FN?"

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the catalogs the more I kept coming back to the little Knight-Kit T-60. Lots of kits were pretty keen deals but the Knight-Kit seemed to hit me just about right. Larry says I can't go wrong on that . . . what you think about it?" "Well son, Larry is right; the T-60 is a neat little package and not too difficult to put together and get on the air. You know of course that it also has modulation in it which involves a bit more work than just a straight CW kit assembly but not at all beyond you. You'll probably want to work a bit of phone after you get your General license so you're that much ahead. About all you'll need to add when you get the higher grade ticket is a VFO and you can pick one up at a modest cost or you can build one if you're so inclined. I'll go along with you on the T-60 and I'm sure you'll find it a dandy little rig. I'm sure you won't have any trouble putting it together and wiring it but if you need any help, drag it out here and we'll both get on it". "Thanks FN," replied Joe, "but you've already done a lot for us kids and Larry has offered to give me a hand if I need it so I think I'll tackle it on my own and bring it out for you to look over and test when I'm through with it. The little thing is just within my budget so I'm going to order it from Allied tonight as long as you've OK'd it. It only has to come from Chicago so I should have it in a week or less". "OK lad, go ahead and buy it; I've seen and tested quite a few of those little rigs and if you do a reasonably good job in putting it together and follow the book right to the dot, you'll have yourself a nice piece of gear. Like I told Judy, I'd like both you kids to let me know two things; tell me when you get your transmitters and let me know when you hear from FCC. You probably will both be ready to go on the air by the time your license is in your hands. Larry told you I suppose, that it takes more than a few days to hear from FCC?" "Yeah, FN; waiting will be a bit rough but nothing we can do about it; we'll let you know when word from FCC and our transmitters shows up". So saying. Joe hopped his Honda and took off, stopping at Judy's on his way home to compare examination reactions. As their session lasted all afternoon, obviously it was not entirely concerned with electronics!

Next installment: Judy and Joe reach the top of the novice ladder!

Ham Public Service and Broadcast Stations

Ross Sheldon 3313 Avery S.W. Huntsville, Alabama 35805

In any major town there is certain to be a broadcast station specializing in spot news. Such stations have both phone patch and phone recording equipment. They welcome phoned-in tips and recorded news stories.

Here in Huntsville, Alabama, as a part of the Huntsville Amateur Radio Clubs program of public relations and public service, spot broadcasts giving hurricane news picked up by ham radio are broadcast regularly during the hurricane season. If other clubs decide to do this, here are some tips:

Care should be taken to confine broadcasts to specific hurricane information, omitting names and reports of damage, injuries and other such "scare" items. Such items are usually exaggerated and often completely false. Leave that type information to the news gathering agencies.

Following is the script of one of the broadcasts made here, which others may use as a guide:

(BACKGROUND MORSE CODE ON RECEIVER LOUD THEN FADE)

"This is Ross Sheldon, an amateur radio operator, relaying to radio station WAAY the latest hurricane Alma information as received by amateur radio from amateurs in the Carribean area.

"The amateurs from Puerto Rico to the Canal Zone and along our gulf coast report that Hurricane Alma is now 230 miles SSW of Ft. Myers, moving at 16 miles per hour in a northerly direction. It should pass abreast of Ft. Myers, moving at 16 miles per hour in given as to when or where it will strike the central gulf coast.

"Winds at the center are 110 mph with gale force winds spreading out 250 miles in all directions.

"Shortwave listeners wishing to hear upto-the-minute information on the hurricane should tune to the amateur radio hurricane net now in operation on 14,325 kHz where tape recorded weather bureau reports and other hurricane information is being relayed to isolated areas by amateur stations engaged in hurricane duty.

"This is amateur radio station K4HKD re-

turning you to WAAY."

(BACKGROUND CODE UP AND OUT)
Note the favorable publicity given amateur
radio by these broadcasts which are a public
service to the people in the threatened area
and to relatives and property owners out-

side the area.

To get information, tune to, but do NOT transmit on, the hurricane net frequencies. Relay stations will repeat weather bulletins several times, so you do NOT have to ask for fills. PLEASE DO NOT TRANSMIT!! Note the stated time of the weather bulletin. If it is an hour old and the hurricane is traveling 20 mph, the center is obviously 20 miles farther along. Correct for this in your report. WARNING! Do NOT forecast the eventual route the hurricane will take. Hurricanes change direction quickly and unpredictably, hence even the weather bureau will not predict the complete path. Damage suits from those claiming the wrong forecast lulled them into a false sense of security are possible. Just stick to the facts and DON'T SPECULATE OR TRY TO INTERPRET.

Lay your groundwork in advance by finding out which stations will accept information by amateur radio. (Showing them this article might be a good idea.) Ask whether they just want the information, or wish to tape broadcasts by phone. If they have a teletype which gives them the same information you hear the hams passing on the air they will be interested primarily in the "color" of the spot broadcast from a ham, plus whatever additional information you may pick up.

Type up a complete broadcast, leaving blanks to fill in with the changing data in pencil. (distance and direction from what city, wind velocity, direction and speed of travel, etc.). Read it aloud at least twice at newscast speed to see how it sounds and times before calling the station to record the tape. The shorter the tape, the better. I aim for 50 seconds with a minimum of 30 and a maximum of 90 seconds.

It's a public service—and darn good public relations. If you can swing it.

. . . **K4HK**D

Gus: Part 24

At the end of the last chapter I had just entered the Union of South Africa from Bechuaniland, one of the most desolate spots I have ever seen-or at least the portion I saw. At least the good roads I found in South Africa made the rattley old bus a lot easier to ride on and I could again open my mouth without fear of my upper plate falling

out, and this was good!

We stopped at the little Customs House at the border and in we all went, me and those genuine Africans (I was the only European on the bus, and I did look sort of "out of place"). I guess I had even soaked up some of the usual "aroma" that the Africans have. I noticed that the Customs Officials did not get too close to me for some reason; I guess that "aroma" caused it. I guess he had me tagged as some crazy American, poor as a church mouse, riding that African bus (he had me tagged right too). He must have figured that it was not possible for someone like me to have anything of real value since the questions he asked went somehing like this: where were you born, what nationality and color were my mother and father, (maybe I had gotten a little suntan by this time making me look somewhat off-color to him), did I have any fire arms, any ammunition, any transistor radios, or political affiliations and with whom? He made a few tick marks on the customs forms and said sign here—this I did gladly. As there was no inspection of anything on the bus, the Africans and I piled back on and away we went for what they call Jo-burg (Johannesburg to you fellows).

I was met by ZS6IF, Lamberth; everything was loaded in his car, and away we went for his QTH. I headed to the shower to change my color and smell; I really needed that shower and when I emerged from it I felt like a changed man. Boy, it was wonderful! We went to Lamberth's shack to the rear of his garage. Lamberth is a Dutchman who OSYed to ZS land some years ago; I think he said about 1955 or so. By the time I arrived he had changed 100% from being a Dutchman to a South African.

His was just about the cleanest, smoothest, slickest ham shack I have ever seen. Everything was home built and I mean beautifully built. Everything looked as if it was just finished, cleaned up and polished yesterday-it might have been too. Lamberth was one of those typically thorough Dutchmen in his job and you could see it was finished by a master craftsman right down to each screw being tightened up so the screw slots were even lined up; each solder connection was one of the wiped jobs, the kind most hams don't have the time or inclination for anymore. His keyer, key lever, etc. were all home constructed. It made me glad to know that there are fellows in the ham world who still go to all the pain and strain to do such masterful work as Lamberth had done there.

We sat in his ham shack and had one of those fine business eye-ball QSO's-the kind any of you fellows would like to have with some of the DX stations in distant parts of the world. He wanted to know about any number of W/K DXers he had heard and been working all these years and all about their rigs. He wanted to know the type of bottles, plate voltage, and current they used; also, all about the kinds of antennas the top boys were using in the States. Luckily, I think I personally knew every fellow he asked me about and I even knew something about many of their rigs. I could never be sure of the exact plate voltage or current they ran; most of them did use a kilowatt more or less when I visited them, but at that time nothing rare was coming through—you might say the going was not on the rough side at that moment

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One only . . . COLLINS KINEPLEX RCVR/XMTR TE-202F-5 & TE-202E-1. \$200 takes all.

Don't have any info on this but it's racks of transistorized equipment & with power supplies. If you know what It is you can steal it for ______\$200.00

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-so just one kilowatt. You can't be too sure of what might happen to the voltage and currents later on!

Lamberth and I sat there and yakked away, drinking some wonderful Dutch coffee his wife brought in to us every now and then. Lamberth still had some of that Dutch accept and his wife's accept was very strong. His children spoke perfect English and I think all of them spoke the native language they call Afrikans, which is a combination (I think) of Dutch, English, Flemish and maybe even a few other European tongues mixed with some native South African dialects. They say it's a very difficult language to learn. I don't know because I don't think I ever learned more than two or three words of this complicated, tongue-twisting way to speak.

The next morning we went out in his back yard and looked over his beam—I think it was a quad. He showed me the moon bounce dish he was constructing—it was a real beauty, absolutely perfectly built. I hear now that Lamberth's interest is moon-bounce or tracking satellites and other UHF activity; since I have not been hearing him on the bands, I suppose this may be true.

Lamberth and his wife were very FB hosts to me. Lambreth drove me around Jo-burg quite a bit, showing me the various sights there. One of the oddest things to be seen are those huge mountains of earth in and around Jo-burg. We stopped beside one of them and I got out of the car to look at it closely. It seemed as if it was almost as hard as cement—not a blade of grass was seen growing on these hills. I asked Lamberth why this was and he told me the chemical process they used to extract the gold made it impossible for anything to grow.

I talked to a ZS station a few years after my visit there and he told me that some chemist had found that it was now possible for grass to be grown on this rock by some kind of treatment to the soil. I think he also said that a special grass seed was used to seed the tops of some of these mounds. He told me that someone had built a drive-in theatre on top of one of them, so I I guess they won't be absolutely useless from now on.

Lamberth drove me out to spend the night with Brian, ZS6ANE (America North East as he calls it). He lived all they way across town from Lamberth. Brian is a young married chap with one little girl who was about 3 years old. He is a very likeable fellow with a wonderful wife. We went to his hamshack and sat up quite late having a good eyeball QSO; there were even Cokes in the Fridge, which made the stay with them that much better. The next few days were spent visiting a number of ZS6 fellows and seeing their ham shacks. All were very well equipped and had good antennas; they all seemed to be good operators.

Oh yes, Lamberth asked me if I had declared my gear to Customs when I had entered the country; I told him I had not. That's when he said that it was going to be very difficult trying to get it out of the country when I was ready to depart. I told him I had never had any trouble getting things out—getting them in yes, but not getting them out. He said, "Well, you have never tried getting things out of South Africa yet." I did find a solution to this problem later on but that's another story and will be dealt with in full at the point where it enters the story. It worked out quite well in the end.

I really got to see some of the country around Johannesburg, spending about 5 or 6 days there, sort of biding my time for the departure date of the ship to Tristan, Gough and Bouvet Island. I found I had a few more days to spend between Jo-burg and Capetown so I got in touch with Sid, ZS4MG, in Kroonstaid (about one-third the distance from Jo-burg to Capetown). I gave him a DX phone call and made arrangements for him to meet me when I arrived there via the train from Io-burg.

The train arrived in Kroonstaid about 1 AM and there was Sid at the railway station in his little car—with his little goatee and all. When he arrived at his home his very sweet wife was still up—she even had a big supper on the table for me. I could see immediately that my stay with them was going to be one of the stops where I could pull off my shoes, roll up my pants, and dive into the Fridge when I wanted to.

They told me to make myself at home while there and that's exactly what I did, every minute of my stay. I was even allowed to operate from his station—up to then I had not done very much operating from ZS land. I had a number of FB rag chews with Gus Watchers, as some of them called themselves. I told them how things were progressing towards my forthcoming trip to the islands. I always believe in keeping the





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fellows back home well informed so they can be on the air when you arrive at a rare country.

I knew all about some of the fellows taking days off from their work to contact me. I knew many of them would want to know which day they should play sick. I had even heard of one of them flying back to his home in Ohio from his Texas vacation spot just to work a new one. There is, I am told, a doctor in NYC who will leave his patient on the examination table when one of the fellows gave him the land-line buzz that I was on the air. Bill Eitel of Eimac told me that so many of his crew got sick on the first day I landed at some spot and got going, that their production was very drastically cut! Of course, I think he was pulling my leg.

I can't see any real reason why, under normal conditions, a fellow can't tell you where and when he will be at such and such a spot, provided he knows when it will be. You go on a DXpedition to work as many fellows as possible and this is one way to make sure you get plenty of callers when you get going from a "gud one". Sometimes I know it's not a good policy to announce too far in advance where you are planning on going; there is the possibility of some eager beaver beating you there or maybe getting telegrams or air mail letters to London to stop you. Under these circumstances it's always best to play it cool and keep your mouth shut. I learned this the hard way on the Chagos trip. This might explain why Don Miller stays real quiet most of the time as to where he is going or planning on going.

Sid had a very nice peach orchard right in his back yard, the peaches were about one to two months from being fully ripe, and that's when I told him and his wife I most certainly would stop by and see them on my return from the islands. I told them about my being from the part of the USA where peaches and watermelons grew the best and how I loved to wrap my lips around peaches and whipped cream (um umm). He said he would hold a few treefuls just for me to eat upon my return.

I sure hated to leave Kroonstaid with all that fine home cooking and the real friendship that both of them extended to me, but I kept looking at the calendar and saw "D" day for the ships departure from Capetown creeping up on me.

Late one evening I boarded the train for Capetown; Sid and his wife and daughter saw me off, and away I was for Capetown. A really smooth ride all the way down. Those South African trains are very plush and smooth riding and the food in the dining cars is very good and reasonably priced. The cost of the fare was reasonable too. Arriving in the vicinity of Capetown at sunrise the next morning I could see that it was quite hilly around the country and city.

Marge and Jack-ZS1RM and ZSIOUmet me at the railway station. They had the mayor of the city along with them, and after a very fine welcome, they insisted we stop at a cold drink bar for a Coke (it took practically no convincing, I must say). As usual when we sat down and ordered the drinks, (we all ordered Cokes) I told the waitress to be sure to bring mine in the bottle, please. She said OK, and as is usual, she brought it to me in a glass.

I refused the drink and told her I wanted it in the bottle; with a half frown she then brought me another, this time in the bottle. The mayor said, "There is no difference," and that's when I said, "Oh, yes there is, I am a connisseur of Cokes, I know when they are best." He and Jack and Marge had theirs in a glass, then they all ordered another Coke in the bottle. Right there in the drink bar they had a sip and smack test of Cokes-they would sip a little from their glass, then take a swig from the bottle; after a little of this testing all three decided that there is a difference. They all said it was much better directly from the bottle!

If I did nothing else in South Africa, I converted three people to drinking Cokes the right way-directly from the bottle! After this little episode the mayor departed, I guess for his office, and Jack, Marge and I departed for The Strand where they lived in an upstairs apartment overlooking the beach. The Strand of Capetown is a beachside resort area, a sort of holiday spot, where everyone goes on the week ends to swim, fish, golf, etc. Marge works in a beauty parlor and Jack sells insurance. They are not in the wealthy class at all; they are regular down to earth kind of people and their's is not a fancy apartment. They had held a bedroom especially reserved for me, and their Fridge was jammed full of Cokes, fresh figs, Cape grapes, cantelopes, watermelons, and other goodies.

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196-23 Jamaica Ave. Hollis, N. Y. 11423 They took me into the radio shack (which is not unusual you know) and I was shown how to turn on the rig, turn the beam, and they said, "Gus, the rig's yours as long as you are here with us. Make yourself right at home and sleep as late as you wish." After a good many hours of eye-balling they departed for bed, leaving me in the shack. I immediately went on the air, getting on 14065, my DXpedition frequency; called a CW CQ and had quite a ball working the boys in the States, telling them that Tristan da Cunha and Gough and Bouvet were getting closer and closer all the time.

I stayed up until about 3 AM having myself quite a ball I must say. I dragged myself away from the pile-up that was still calling me and slept until 10 AM the next morning. When I got up, Marge and Jack had left a note on the rig, so I would be sure to see it I suppose, telling me to go right ahead and fix my own breakfast; they had to go to work. This was really making me feel right at home—they had turned the whole house over to me and they again said I could use the rig as much as I wanted to.

I had a very leisurely breakfast of coffee, cantelopes, even ate a big slice of water-melon—for breakfast. Man, this was like being back in South Carolina eating water-melon for breakfast. I did miss my grits and sausage and eggs and Peggy's cooking though.

. . . W4BPD

VK7TR

VK7TR, Ray Conrad of Hobart, Tasmania, was completely burned out in the great fire which recently swept the South Australian Island. His home and all contents including all his radio gear, QSL's and logs were completely destroyed. Ray and his XYL escaped in their car from the fire which descended on their home at 75 mph. If those to whom VK7TR owes QSL's will send new cards to his old OTH or to VK7CK, he will attempt to OSL from memory. Ray and his XYL are leaving April 22 for an extended trip stateside via England. He expects to hit New England and Pennsylvania after August 20, then on west across the USA and back home. Don't be surprised to hear his melodious accent from G3LSF, W1BCR and W3CES and others.

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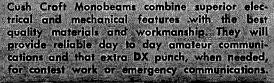
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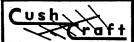


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Letters

(cont'd from page 4)

Dear 73.

Your March issue of 73 Magazine with the 73 transistor circuits is by far the best issue I've ever received . . . I work the Air Force MARS CW Transcon Net and used the audio passband filter described in Fig. 14 between the headsets and the receiver. It sure does the trick at 7332 kHz which is close to the CHU time signals. It completely eliminated CHU and brings CW signals up no end—hence I am figuring on setting the thing between the first audio and second detector of my receiver. This way I won't have to wear a set of "cans" all the time.

With this filter in my receiver I am able to give all the fellows a QSA5 QRK5 signal report, but when I take it out there is so much crud on the darned frequency that it knocks 'em down to 2/2 for sure.

Charlie Holstrom WA 0 GYK Fairbnry, Nebraska

Dear 73

I am particularly interested in transistors and while all 73's are good, this one is the goodest—uh huh. So send 3 copies of March please. I have some kids I'm getting started in transistors too.

Walt Burdine W8ZCV Waynesville. Ohio

Unhappy

Dear 73:

I have just one fault to find; the magazine gets here very late . . . very fine on everything else. I think you are putting out a fine magazine and I will support it all I can.

Glen Wilson WA6ORZ San Pablo, California

This issue was mailed on May 20th. The July issue will be mailed on the 10th of June. After that all magazines will be mailed by the 10th of the preceding month.

Kudos

Dear 73:

I just had to sit down and write you a letter. What about? Many things, —first of all, about the quality of 73's articles. Superb! In the past eleven years of hamming I know of no mag that equals yours.

hamming I know of no mag that equals yours.

Scanning a typical issue of 73, the transistor articles immediately catch my attention—I usually spend at least an hour on these gems—next a quick trip to the back, the best place to begin reading any mag, plus I always find something interesting in New Products and Books.

Whenever Jim Fisk describes some phase of hamming through his high quality booklets—he receives my vote every time! More of the same Jim! The technicians up here found the Coaxial Handbook invaluable, but myself—being a solid state nut—devoured "73 Useful Transistor Circuits".

Roy Schoonover 3C8AG/VE8 Winnipeg, Manitoba, Canada

Dear 73

More than 50 years ago I purchased my first ham radio equipment. The receiver was slider tuned with an electrolytic detector using a Wallaston spring wire contacting an acid solution in a carbon cup. The transmitter used a spark gap.

Today I'm still enthused as I read your selected articles on new equipment and how to build one's own.

Phil Shlgley WB6SJA Redding, California

Dear 73:

For the past several years now, I have enjoyed receiving my copy of "73 Magazine". I look forward to seeing many new and different approaches to construction articles and feel that this magazine keeps me more than adequately supplied.

Incidentally, I also write a weekly column for one of the local newspapers and find this very rewarding with respect to the interest generated in 'the hobby'.

Hoping to build up the Transistorized Digital Identification Generator and have already written to Barry Todd regarding the diode matrix. Last summer I got "hooked" on the integrated circuit keyer, and can only say that it works like a champ.

can only say that it works like a champ.

RTTY is my chief interest these days, would sure like to see more articles in this vein. Possibly I can add my two cents worth at some future date.

James H. Sayer, VP9BY Smiths Parish, Bermuda

Dear 73:

I saw a March 1967 issue of 73 magazine last night at our ham meeting and it sure did impress me. All those real interesting transistor circuits. I don't see how you can put so much good information in one publication.

I have been taking the ARRL QST, but my subscription is up and I am going to take 73.

You may be interested to know that one of our ham friends who is well educated in electronics made the statement last night at the ham meeting, "I have been taking QST magazine, and I am so far behind I was unable to read 73." That is how much he has been missing my not subscribing to your magazine earlier.

Please start my subscription with the March 1967 issue—I sure do want that book.

Levy Belcher K4TSX Glasgow, Kentucky

Dear 73:

Congratulations on the February 73 which arrived here today. I have been a subscriber of 73 from issue number one and have written publicly about it in our Break-In—you have now hit the jackpot with the new binding. Of the material inside, there is always much of interest for me so I continue to rate the magazine number one . . .

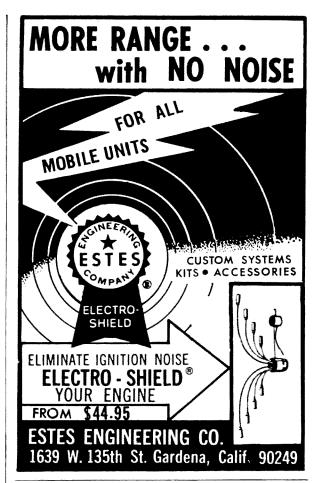
Jock White ZL2GX Contest and Awards Manager New Zealand Association of Radio Transmitters

Dear 73:

I've been wanting to tell you how much I, a non-ham, enjoy much of 73. I'm not qualified to comment on the technical articles (my husband says at least once a month, "73 sure has it beat over the other two"), but I certainly find the overall magazine much more appealing than CQ or QST. I've taken a "beginning beginner's" course in electronics and absorbed quite a bit by osmosis (what wife could avoid that when her husband is afflicted with the disease of ham radio!) and occasionally I even find a technical or general information article I can muddle through.

I don't want to ramble on, so I'll just say that in this household 73 is considered tops.

Mrs. Heather Jorgensen XYL of K1DCK



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73 Magazine CUMULATIVE INDEX

October 1960-December 1966

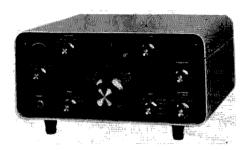
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73 Magazine

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Heathkit SB-301

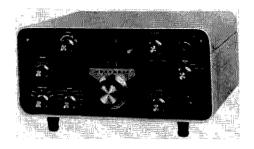


The new Heathkit SB-301 Amateur Band Communications Receiver is an improved version of an already famous pacesetter, the SB-300. Some of the new features of the SB-301 are increased sensitivity, full RTTY provisions, 15 to 15.5 MHz coverage for WWV, built-in automatic noise limiter, and front panel switching of the optional six and two meter converters.

The SB-301 covers 80 through 10 meters with provisions for AM, CW, upper and lower sideband and RTTY. It has a crystal-controlled front-end which provides the same tuning rate on all bands. The pre-assembled and calibrated Linear Master Oscillator (LMO) features linear tuning and excellent stability. The sensitivity of this new receiver is better than 0.3 microvolts for 10 dB signal-plus-noise to noise on all bands. The built-in crystal filter exhibits selectivity of 2.1 kHz at the 6 dB points for SSB and RTTY. Optional filters are available for AM (3.75 kHz) and CW (400 Hz).

The SB-301 is fully capable of transceive operation when operated as a companion to the SB-401 transmitter. When the optional six and two meter converters are plugged in, the SB-301 provides full amateur band coverage from 80 through 2 meters complete with front-panel switching. Look for a complete review of this versatile new receiver in this issue. For complete specifications and the schematic diagram, write to the Heath Company, Benton Harbor, Michigan 49022.

Heathkit SB-401



The new Heathkit SB-401 80 through 10 meter SSB Transmitter is an improved version of the widely chosen SB-400. The engineering department at Heath has added many new features to this rig to make it even more versatile that its predicesser. The new SB-401 offers a front-panel control to switch from independent to transceiver operation when used with the Heathkit SB-301 (or SB-300) communications receiver. This control and the allied circuitry that go with it also enable the SB-401 to be operated as an independent transmitter with any communications receiver—all you need is the Heath SBA-401-1 crystal group.

One of the amazing things about this new transmitter is its cost—it is forty dollars less than the preceding model! Even with the optional crystal group installed the new SB-401 is ten dollars less. The specs of the new SB-401 are just about the same. It still runs 180 watts PEP on SSB on 170 watts CW. Linear tuning is provided by the Linear Master Oscillator and the 1 kHz dial calibration permits frequency repeatability within 200 Hz. It features a built-in antenna change-over relay, a relative power meter, VOX and PTT control, and LSB, USB or CW.

In addition, Heath has changed their assembly plan to "sub-pack" packaging. Now basic portions of the transmitter are assembled as individual units. The builder opens only the packages of components necessary for that part of the SB-401 he is about to assemble. Unit by unit he progresses toward completion. In this way, the number of components involved at any sequence is cut down and there is less chance for error. Besides, it's easier.

For more information on this new transmitter, and a complete set specifications and the schematic, write to Heath Company, Benton Harbor, Michigan 49022.

(Turn to page 132)

BAND TRAP ANTENNA



Reduces laterference and Moise en Ail Makes Short Wave Receivers. Makes World Wide Reception Stronger.

Clearer en All Bands!

Complete as shown total length 192 ft. with 96 ft. of 72 ohm balanced twinline. Hi-impact molded resonant traps. You just tune to desired band. Excellent for ALL world-wide short-wave receivers and amateur transmitters. For NOVICE AND ALL CLASS AMATEURS! Eliminates 5 separate antennas with excellent performance proven. Inconspicuous for Fussy Neighborhoods! EASY INSTALLATION! Thousands of users.

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New Products

(from page 130)

Poly Quad Antenna Kits

The Polygon Plastic Company has entered the amateur radio field with a unique fiberglass cubical quad antenna kit. Already a nationally known manufacturer of industrial fiberglass products and the "Glas-Lite" fiberglass sporting goods line, Polygon has adapted a three piece tube with strength equal to, or even greater than, the best 13 foot continuous length pole.

The entire kit is mailable, thus reducing shipping cost and time. Most important is the sky-blue epoxy paint used on the standard kit spreader. This paint protects the fiberglass from weather and ultra violet ray deterioration adding years to spreader life. It also tends to make the mounted antenna less conspicuous and therefore, less objectionable to neighbors. The most advanced and economical feature of the kit is the spreader mount-called the Starmount. Using only a wrench and screwdriver, the amateur can adjust the Starmount to fit booms from 2 to 3 inches in diameter. He can go from dual to multi-element arrays without buying all new hardware. The Starmount is diecast of proven corrosion-resistant, high strength aluminum alloy. The boom-to-mast adapter is also fabricated from a high quality aluminum alloy.

A comprehensive and illustrated 28 page manual offers simple instructions enabling the average Ham to construct the Poly-Ouad in a matter of hours. Selection of boom. wire and reflector tuning methods is left to the individual customer. Kits are available with 2, 3 and 4 elements in iri and duo-band series. Components are also sold separately. For more information, write to Polygon Plastic Company, 7 Industrial Park, Walkerton, Indiana 46574.

Amperex Linear IC's

Amperex has announced the availability of five new linear monolithic IC's. The most advanced type in the line is the TAA320, an optimum performance audio frequency semiconductor device. Trade-named 'BiFET', it is the world's first bipolar/mosfet integrated circuit amplifier. This new design concept enables the unit to take 100 volt transients, features a G_m of 40,000 µmhos and has an input resistance of 10,000 megohms.

The new model TA310 is designed specifically as a record/playback preamplifier. It provides 100 dB gain with less than 4 dB noise. The TAA293 features complete accessibility to all internal connections to provide wide application flexibility. It is ideally suited for audio and if applications, or as an amplifier, oscillator and multivibrator in other low-frequency functions.

The new Amperex TAA103 is the smallest linear integrated circuit amplifier presently available. The plastic flat-pack in which it is packaged measures a scant 0.002 cubic inches. This IC features 75 dB gain and is ideally suited for amplifier applications from dc to 600 kHz.

For more information on this new line of integrated circuits, write to Amperex Electronic Corporation, Semiconductor Division, Slatersville, Rhode Island 02876.

Aerovox RF Suppression Filters



Although these filters were designed for the military market, they should find use in amateur equipment where severe rf suppression requirements exist. These miniature ceramic filters come in twelve different models for rf suppression from 150 kHz to 10 GHz (10,000 MHz). For more information write to Aerovox Corporation, Olean, New York.

WRL 1967 CB Catalog

Although this new catalog from World Radio Labs was put together specifically for the citizens band operator, there are many items included which are of interest to the amateur. Test equipment, antenna accessories, feedline, rotors, tools and components are included as well as a full line of CB gear. For your free copy write to World Radio Laboratories, 3415 West Broadway, Council Bluffs, Iowa 51501.

(Turn to page 184)



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SS611	50-54	7-11	21.95
SS611F	Same as above	but FET rf amp.	89.95
SS510	50-54 MHz rf	pre-ampl ifie r	9.95
SS511	50-54 MHz FE	T rf pre-amplifier	29.95
SS600X	Special IF (.6	-30 MHz)	24.95
SS660XF	FET special I	F (.6-30 MHz)	42.95
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New Products

(from page 132)

Top Tuning Piston Capacitor

The Components Division of the JFD Electronics Company has just announced a universal top tuning assembly which adapts all IFD piston capacitors for top tuning and vertical mounting. These units are ideal for applications in equipment where space is at a premium and top tuning is required.

These components are available in two wire and pin or four wire configurations for printed circuit use. The unit shown here has a range from 2 to 25 pF, a working voltage of 500 Vdc, and Q of 600 at 20 MHz. For further information, write to IFD Electronics Company, Components Division, 15th Avenue at 62nd Street, Brooklyn, New York 11219.

Amperex Semiconductor Catalog

Amperex has just announced the latest edition of their condensed Semiconductor Catalog. This new catalog contains the basic specifications and related material on the full line of Amperex semiconductors. It serves as a quick reference guide and includes specification lists and associated applications references on transistors, diodes, audio amplifier assemblies, integrated circuits, heats sinks and audio kits. In addition, there is a list of Amperex Application Reports. Free copies may be obtained by writing on your company letterhead to Amperex Electronic Corporation, Advertising Department, Hicksville, Long Island, New York 11802.

1967 EICO Catalog

EICO has just announced publication of their new 1967 catalog. This new catalog features EICO's complete line of 200 electronic kits and factory assembled instruments for hams, electronic technicians, hobbyists, CB'ers and audio buffs. Among the new EICO items included in this catalog are their 717 Electronic Keyer, 711 Shortwave Receiver, 888 Engine Analyzer and "Cortina" solid-state stereo. Also included are the EICOCRAFT Solid State electronic kits-seventeen different units for many applications. For your copy of this new catalog, write to Electronic Instrument Company, Inc., 131-01 39th Avenue, Flushing. New York 11352.



- ★ Price—\$2 per 25 words for non-commercial ads; \$5 per 25 words for business ventures. No display ads or agency discount. Include your check with order.
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WANTED IP-501 receiver write box 77 Savannah, Georgia, 31402.

WANTED SW-3 receiver write box 77, Savannah, Georgia, 31402.

NEW T-4X, \$325, AC-3, \$65, unopened factory cartons, warranty, new, sealed. 3-400Z tubes, pair \$55, singles \$28, warranty. W4HKQ, Don Payne Box 525, Springfield, Tenn. 37172.

NEW SWAN 500, 117XC speaker, supply unopened factory cartons, warranty, \$478. HQ-170, clock, manual, mint condition, \$115. W4HKQ, Don Payne, Box 525, Springfield, Tenn. 37172.

TRANSFORMERS: Filament-transistor power supply: 6.3 VAC at 1.5 A, 115 VAC, \$1.00 each pp anywhere in U.S. No minimum order. Electro Systems, 3496 Zisch Dr., San Jose, Calif. 95118.

RECORDING TAPE: Name brand splice free. 1.5 mil mylar, 1200 ft, \$6.50 for 5 reels; 1.0 mil mylar, 1800 ft, \$9.00 for 5 reels, pp anywhere in U.S. Electro Systems, 3496 Zisch Dr., San Jose, Calif. 95118.

ANTENNA FOR SALE! Mosley A-315 15 meter mono bander. Never used. \$25. You pick up or pay delivery. Russel Appleyard, 16 Coolidge St., Larchmont, N.Y. 914-834-3470.

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NCX-3 & NCX-D supply both in very clean and good operating condition, package deal \$275. Ed Baldus, 5365 Dockweiler Pl., L.A., Calif. 90019, tel 213-933-0485.

RF SIGNAL GENERATORS: I-122, \$24; LAE, \$8; HB superhet, \$18; TS-34 scope, \$20; uncalibrated LM-14, \$21; also have CQ, QST, books, TM's, parts and other test equipment. Send for free list. John R. Yurcik, K2EMF, 510 Conklin Place, Linden, N.J., 07036.

SWAN 350 & AC power supply, \$300. In mint condition. Will ship prepaid on receipt of check. C. Cowles, K9KNG, 831 N. 8th, Manitowoc, Wisc.

SIMPSON MULTIMETER, (VTVM) model 266, \$19; Heathkit signal generator, \$18; Heathkit VTVM, \$18. Good working condition. H. Goldman, 43 Clinton Ave. Rockville Center, N.Y., 11570.

HEATH SB-300 with filters, \$250; SB-400, \$295; SB-301-3, \$19; Table top KW linear, \$125; others write. Shideler, 2812 Tenth, Arcadia, Calif.

VIKING-1 6146's PA TVI'd VFO PTT filter RCA AR88LF 60KC-30MC all \$150. Buyer inspects/collects. K2BJB, 25 Tudor Ave. Pine Beach, N.J. 08741

VIKING VALIANT, \$170. HRO-50 with crystal calibrator and 5 coils, \$125. Central Electronics 10-B, \$45. Albert Thomson, W8DTI, 2645 Forest Grove S.W., Wyoming, Michigan 49509.

HEATH solid state multiplex twins, AA 14 and AJ 14 with bookshelf speakers, all in oiled walnut. Ranger 1 and Vanguard 6 mtr conerter w/10 meter out. Sell or trade for transceiver. Robert F. Cann, W4GBB, 815 Ben Franklin Dr. Sarasota, Florida 33577.

SWAN 120 with mike, \$120. Topaz mobile 800 V power supply, \$50. Will ship. H. A. Hindert Star Route 2, Fischer, Texas 78623.

HEATH SB-300 receiver, cleanly wired, excellent operation, like new condition, used 6 months during novice period. Will ship FOB for \$175. D. W. Frye, WA3CKZ, 328 Castlegate Rd. Pittsburgh, Penna. 15221.

HQ-170-C, \$175; DX-60, \$55; HG-10 vfo, \$25; 10-D mike, \$15; HM-11, \$10; Matching speaker for 170, \$10. Also key, etc. First certified check for \$260 takes all. Singly as listed. D. Callaway, Rt. 1, Box 303, Durango, Colorado 81301.

BACK ISSUES: 73-CQ-QST-Radio. Write, for list. W. Conant, 15424 Chase St., Sepulveda, Calif. 91343.

DUMMY LOAD 50 ohms, flat 80 thru 2 meters, coax connector, power to 1 KW, kit \$7.95, wired \$11.95, pp Ham Kits, Box 175, Cranford, N.J.

CLIFF DWELLER 75/10 meter rotatable dipole. First owner, not rusty, \$50; HT32A immaculate condition, \$250. Want transceiver. Marty WB6-NWW, 5349 Abbeyfield, Long Beach, Calif. 90815.

SWAN 250 AC SUPPLY, Mark VI Linear, many extras, Johnson 6N2, National VFO, Tapetone WTC-1300; best offer. Richard Solomon, 25 Regina Rd. Dorchester, Mass.

FOR SALE: Swan 350 w/AC power supply, \$375.00; SB-200, 1200 W PEP linear, \$175.00; HA-650 6-meter portable xceiver, \$100.00. All equipment mint, perfect working order. Ken Feldman WB6FRP, 705 Gayley Ave., Los Angeles, Calif. 90024.

SELECTRONIX AUDIO FILTER, use between receiver and speaker or phones, cuts monkey chatter and narrows band pass to about 1000 Hz. Some QSO's possible only with this in circuit. \$24.95 pp. W0RA/1 Box 115, Greenfield, N.H. 03047.

NATIONAL NCX-3 and NCX-A power supply, mint condition, \$290. Electro-Voice mike and PTT stand, \$20. Randy Brook, WA2PPE, 534 W. 114th St., N.Y.C. 212-662-0232.

GONSET G-76. Transceiver. Both factory power supplies and mike. Very good condition, \$175.00. Will ship, you pay charges. D. Frahm, 714 San Miguel, Sunnyvale, California 94086.

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	KWS-1	2.75 to 3.75 MHz		\$39
	KWM-1		2½W x 2H x 2½D	\$29
Term	s cash, fu	ıll refund if yo	ou are not sat	isfled
withi	n 10 days.	-		

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wanted: test equipment, laboratory quality such as Hewlett-Packard, General Radio, Tektronix, etc. Electronicraft, Box 13, Binghamton, N.Y. 13902. Phone: (607) 724-5785.

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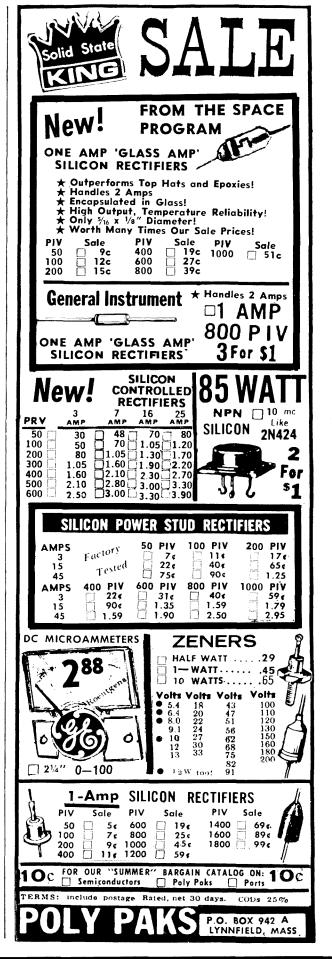
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Propagation Chart

JUNE 1967 ISSUED APRIL 15

J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7A	7	7	7	7A	14	14	14	14
ARGENTINA	144	144	144	14	14	14	14	14	21	21	21A	21
AUSTRALIA	14	14	14	14	7B	7	74	74	7	7	14	14
CANAL ZONE	21	21	14	14	14	14	14	14	14	21	21	21
ENGLAND	14	14	7A	74	7A	14	14	14	144	144	144	144
HAWAII	144	21	14	14	7	7	74	14	14	14	14	14
INDIA	14	14	14	7B	78	7B	14	14	14	14	14	14
JAPAN	14	14	14	14	7	7B	14	14	14	14	14	14
MEXICO	144	14.	A 14	14	7	7	14	14	14	14	144	144
PHILIPPINES	14	14	14	74	7B	7B	74	7.4	14	14	14	14
PUERTO RICO	14	14	14	7A	7	7	14	14	14	14	14	144
SOUTH AFRICA	7B	7B	7В	14	14	14	144	144	21	21	14	14
U. S. S. R.	14	14	14	14	7	14	14	14	14	14	14	14
WEST COAST	14A	21	14	14	7	7	7A	14	14	14	14A	144

CENTRAL UNITED STATES TO:

ALASKA	14	14	14	14	7.4	7	7	74	14 .	14	14	14
ARGENTINA	144	144	144	14	14	7	14	14	21	21	214	21
AUSTRALIA	21	21	14	14	14	14	7 A	7 A	7	7	14	14
CANAL ZONE	21	21	14	14	14	14	14	14	14	21	21	21
ENGLAND	14	14	7.4	7A	7	7	14	14	14	1.4	14	14
HAWAII	21	21	14	14	14	14	74	14	14	14	144	14
INDIA	14	14	14	14	7B	7B	7B	713	14	14	14	14
JAPAN	14	14	14	14	74	7	7	74	14	14	14	14
MEXICO	14	14	14	1.4	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	7A	7B	7B	7.5	1-1	14	14	14
PUERTO RICO	21	14	14	14	7	14	14	14	14	144	144	14
SOUTH AFRICA	7B	78	7B	14	7B	14	14	14	14	144	14	14
U. S. S. R.	14	14	14	14	7	7	14	14	14	14		14

WESTERN UNITED STATES TO:

ALASKA	14	14	14	14	74	7	7	7	7A	14	14	14
ARGENTINA	21	21	21	14	14	7	14	14	21	21	21 A	21 -
AUSTRALIA	21	21 A	21 4	21	14	14	14	14	7A	7	14	21
CANAL ZONE	21 A	21 <i>A</i>	21	14	14	14	14	14	14	21	214	21
ENGLAND	14	14	14	14	7	7	7	74	14	14	14	14
HAWA11	21	21A	21 A	21	14	14	14	14	14	21	21	21
INDIA	14	14	14	14	14	78	7B	7B	14	14	14	14
JAPAN	14	14	14A	14	14	14	7A	7 A	14	14	14	14
MEXICO	144	144	14	14	14	7.4	7.4	14	14	14	144	14.
PHILIPPINES	14	14	14	14	14	14	7	7	14	14	14	14
PUERTO RICO	21	21	144	14	7	7	14	14	14	144	21	21
SOUTH AFRICA	78	7B	7B	14	7B	7B	14	14	14	14	14	14
U. S. S. R.	14	14	14	14	14	7	7	14	14	14	14	14
EAST COAST	144	21	14	14	7	7	7 A	14	14	14	144	147

A. Next higher frequency may be useful this hour.

B. Very difficult circuit this hour.

Good: 1-8, 10-13, 15-17, 19-21, 23-30

Fair: 9, 14, 18, 22

VHF: 5-7, 10-13, 15, 20, 24-27

73

JULY 1967

AMATEUR RADIO









73 Magazine

July 1967

Vol. XLVI, No. 7

Jim Fisk WIDTY Editor

Jack Morgan KIRA Advertising Manager

Published by Wayne Green, W2NSD/I

ADVERTISING RATES

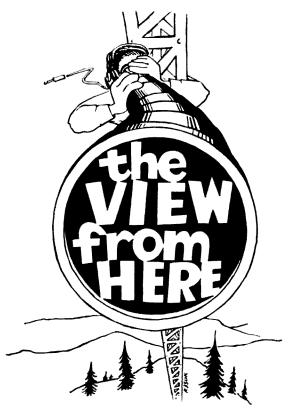
1 p 1/2 p 1/4 p 2"	1X \$298 155 80	6X \$281 147 76	12X \$264 13 9 72
2"	42	40	38
1"	23	22	21

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Double-sideband adapter for AM rigs. A Homebrew 50-Foot Tower	VE6KS 12
Low-cost, self-supporting, tilt-over constructions Simplified Transistor Design for the Ham	VEIADH 14
It's easy when you know Ohm's law. VEØ Ahoy	VEITG 22
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Mobile experimenters take note.	
Amateur radio on the moon.	
Transmit control with the 32S-1 Receiver Without modifying the receiver.	
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It has been pretty well publicized lately that the growth of amateur radio is slipping badly. The total number of hams is not keeping pace with the overall population. In addition, the average age of the ham is increasing while the average age in the country is on the decline.

Although some parties theorize that this decrease is a direct result of the incentive licensing proposal, license fees or some other controversy, a closer look will reveal that our decrease in numbers actually started several years before incentive licensing was even mentioned. Interestingly enough, the first decline closely followed the FCC's announcement of the 27 MHz citizens' band in 1959. Since then we haven't been able to hold our own.

Youngsters used to join ham radio in droves—now they're going to CB. In many high schools it's not unusual for the CB club to outnumber the ham club by fifty to one! It's not hard to explain either. Look at how much easier it is to get a Class D Citizens License—no code and no theory. This state of affairs is not only detrimental to the future of ham radio, it seriously effects the critical shortage of electronics technicians.

The shortage is so critical in some areas that firms are scouting for technicians in other parts of the country. This was unheard of a few years ago. The federal government has tried to curb the shortage of technical people in part by providing financial aid to electronics programs at technical schools and colleges. You can appreciate their concern when you realize that the demand for skilled technicians in our highly technological society is increasing every year.

Thirty years ago the majority of radio technicians was introduced to electronics through amateur radio. This is not true now, nor is it apt to be again in the future—electronics is too diversified. However, if we can interest more youngsters in amateur radio, we will not only offer them an interesting hobby, we will introduce them to the fascinating world of electronics. Some of them are sure to pursue careers in this field.

I'm sure that most hams will agree that the toughest part about amateur radio is getting started. If you don't live in or near a big city, you aren't even exposed to ham magazines. Your public library doesn't have much to offer either. In fact, there is probably a pretty good chance that there isn't even an active amateur in your town. How then, can you be interested in a subject that you're not even exposed to?

If a youngster surmounts these obstacles, locates a local amateur and goes to a meeting of the local radio club, all he meets is indifference. Not always, but usually. Even if he isn't greeted by indifference, he has to sit through a two-hour business meeting before they bring on the star attraction. If he ever comes back after this experience, he has more fortitude than most teenagers. He is more likely to join the local CB group where he can get on the air right away.

To encourage new hams, we have to expose more people to our hobby. At the present rate, in another twenty years ham radio will be all but extinct. In the days of wireless, the big attraction was the uniqueness of sending messages through the ether-even if it was from one end of the block to the other. And when you made it, everybody in town heard about it. In this age of transoceanic television, the fascination of radio is somewhat limited. To get in the public eye you have to do something new and unique-be newsworthy. The only time we get in the newspapers today is when we provide communications during an emergency. We aren't going to attract many new hams if we must depend on natural disasters to get in the public eye. (Turn to page 116)

ROHN.

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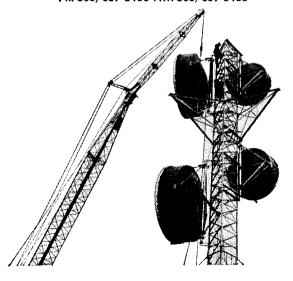
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de W2NSD/1

Don Miller Hassel

never say die

It is reported that well over half of the latest ARRL board of directors meeting was taken with clearing up the Don Miller hassel. Since this matter has been obscured by much misleading information, perhaps we should take the time to look at it and bring out all the facts. Here's what happened.

The entire DX world was shocked to its core when on February 20th the ARRL Awards Committee published an announcement that Don Miller W9WNV had been suspended from DXCC and that many of his recent DXpedition stops would not count for ARRL DXCC. This announcement was sent to the League directors and assistants, to all IARU societies worldwide, to DX clubs worldwide, to all DX bulletin editors and to the DXCC honor roll. Don's reputation worldwide looked to be completely ruined by the claims of impropriety and outright cheating made in the announcement.

Don, who had wind of this, had talked with John Huntoon just two days before it was issued by overseas phone from Mombasa, asking him to hold up until he could furnish documents to answer all ARRL allegations. Don was not given the courtesy of facing his accusers with the proof which he had in hand.

The ARRL announcement was ten pages long, filled mostly with generalities. Specifically they claimed that Don was guilty of poor sportsmanship, issuing QSL's for contacts which never took place to amateurs who had made substantial donations, and even avoiding contacts with leading DXers who had not sent contributions. Don was further accused of misrepresenting certain foreign consulate activities to the award committee, resulting in a decision which later had to be reversed (HC8E and TI9C). Further, the committee claimed that Don's Navassa Island expedition damaged the prestige of amateur radio in government circles and thus the K1IMP/KC4 trip must be disqualified.

(Turn to page 112)

George Cousins 3CITG Box 18, RR 2 Lower Sackville, Nova Scotia, Canada

North of the Border

The story of amateur radio in Canada.

On January 1st 1967 the ears of the amateur world were somewhat startled by the appearance of a whole series of strangesounding calls beginning with the prefixes 3B or 3C, and for a few days we in Canada spent almost as much time making explanations as we did in actual QSO's. The reason, of course, was the advent of our Centennial Year, and as part of a whole series of celebrations we were given the privilege of changing from our normal VE and VO calls to the new prefixes selected from the list of internationally assigned call letters. Thus VO1 became 3B1, VE1 became 3C1, etc., and this state of affairs will continue throughout 1967. This might be a good place to point out that these new prefixes are not obligatory; those of us who would prefer to carry on with the normal VE or VO call may do so, so you will find quite a mixture of calls from up this way during the vear.

Because of this call-sign business and the other celebrations we have planned, no doubt we'll be getting a lot of ham visitors during the months ahead, so perhaps you would like to know a little about our ham radio structure. A few years ago I spent over a year in California—very enjoyably I might add—and regularly attended meetings at a local radio club. I found that whenever I announced my call I was greeted with rather surprised looks, and one night I even had one chap ask me just how radio conditions were in Australia! All of which makes me believe a little information about Canada

would be helpful.

Since we're such close neighbors, it's only natural to compare our set-up here with that of the United States, and the first big difference is in the number of amateur licence classes in Canada. We have only two-Amateur Radio Operator and Advanced Amateur Radio Operator-with nothing similar to the Novice or Technician classes. Our regulatory body is the department of Transport (DOT), whose telecommunications branch maintains offices in major centers across the country. Like the FCC, these are the gentlemen who conduct our examinations, issue our personal and station certificates and monitor our activities. Our rules of conduct are contained in the General Radio Regulations of the Radio Act, which among other things tells us the frequency allocations and modes of transmission which we may use. Depending upon the class of licence held, we may or may not use all the available frequencies or modes, but more about this in a moment.

When a chap in Canada gets the urge to become a ham, his best bet is to drop a line to the nearest DOT office and get a copy of the Syllabus of Examination which gives all the details and outlines the proper procedure. Since we must all crawl before we can walk, the first step is the straight amateur licence, and for this a number of preparations are necessary. Our lad must be a British subject, or, he must be a Landed Immigrant for not more than six years, in which case his application must be approved by the Minister of Transport. He must also

be at least 15 years old, so you won't (or shouldn't) find any real young fellows on the airways up here. There's no upper limit of course, and the inspectors are also very sympathetic towards those with physical limitations. The "really big" step, which is an absolute must, is the learning of the International Morse code. At the time of his examination our budding ham has to send and receive code at not less than 10 words per minute for three consecutive minutes in each case, and consisting of plain language, figures, punctuation marks, and possibly some O-signals and distress signals. Since this is the first part of the exam, and because he must pass this test or discontinue the exam immediately, it's best to be capable of close to 15 w.p.m. before making the attempt. I'm sure we all remember our moments of uneasiness when we sat down at the table and everything seemed to go completely blank just at the wrong time! Inspectors are human too, and a kind word and few minutes of warm-up practice at the key have saved many of us from beating a too-hasty retreat.

Having negotiated the code test, the world seems a little brighter, and our lad now must face an oral exam and answer questions on operating procedures, adjustment of his equipment, and such highly practical things as the elimination of key clicks, BCI and TVI. He will also have to know his frequency allocations.

Whether an oral or written exam is easier makes little difference, since he now has to sit down and write a paper on the fundamental theory of electricity, radio and operation of ham equipment in general. He also has to prove his knowledge of Canadian regulations regarding amateur stations as well as international regulations and procedures.

One might think he would be finished by now, but he still hasn't shown that he could recognize a tube from a toothbrush, so he must now draw a series of diagrams of simple equipment: an amateur type transmitter and superhet receiver, some form of frequency meter, an overmodulation indicator, a wave-trap, a key-click filter and finally, a power supply operating on ac and using full wave rectification and filter. The inspector has the option of asking questions about specific components on the diagrams, so our boy should have a pretty good idea of just what the resistors and capacitors

are actually there for.

He must make 100% on his code tests to pass, but he can get by with 75% on the oral and written exams and 50% on each of his diagrams. Still, by the time he's finished he can use a breather.

If he has failed, he can come back and try again, usually at three month intervals, but let's assume he was a good fellow and came through with flying colors. His certificate and his station licence will be along in a short while, complete with the allimportant call sign. The frequency allocations for this class are basically CW only for all bands from 30 MHz down, and either CW or phone on the bands above 10 meters. The actual frequencies are almost identical to yours in the USA, and even though we are permitted to operate on CW over the whole band we try to stay within the generally accepted CW "portions" and not come galloping up through the SSB and AM stations. For instance, I think it will be a very rare day that you'll find a bunch of VE or stations calling CQ or running CW QSO's up above 14,200-or even above 14.100 for that matter-and the only reason I single out this band for particular mention is because of the steady increase in the CW invasion of the 14.1 to 14.2 foreign phone allocation. Let's think a little more about the "gentlemen's agreement"!

Now that our friend can call himself a real ham, he is free to operate to his heart's content on CW (or VHF phone if he wishes), and after six months, his diligence can be rewarded by the endorsing of his station licence to permit phone operation on 10 meters. No exam is necessary for this, but he must prove that he has actually been operating his rig on CW for these six months. While ten meters was dead and almost forgotten this might not seem of much consequence, but there have been many cases where hams have gotten this 10 meter endorsement and just never got around to going any further. Of course this can be pretty restricting, but just as a VHF man can go along for years without even thinking about the lower bands, a confirmed 10 meter man can spend the same number of years watching the sunspot cycles come and go.

However, our friend has more ambition than this, so even though he has some phone privileges he keeps on improving his CW speed, learning more about procedure, and doing some study on the technical end of radio. He should work diligently because after he has been on the air one full year he is eligible to write his second exam. If he is successful he will receive his Advanced Amateur licence and full phone privileges. At the advanced exam he must sit down at the table again and pass his code test at 15 w.p.m.; again he must achieve 100% copy for three consecutive minutes. After this comes a written test on advanced radio theory and equipment operation, with special emphasis on telephony, and another test on regulations and procedure.

Although the main advantage of successfully passing this exam is the granting of phone privileges on 15, 20, 40 and 75 meters, there is a little more than this. As you probably know, our phone allocation is somewhat different than in the USA and starts at 3725, 7100, 14100, 21100 and 28100 kHz. Therefore, we have the benefit of a few more kHz to enjoy. Of course, don't think this is all peaches and creamwe find ourselves competing with most of the rest of the world on these "extra" frequencies. Remember too that our bands on 80 and 40 meters, especially our lower phone allocation, are the same as your CW allocation. We have to live together in one piece of the spectrum and learn to like it. I didn't mention anything about 160 meters, but perhaps I should at this point. Our allocations are in four steps-1800-1825; 1875-1900; 1900-1925; and 1975-2000 kHz. We can use both CW and phone. The big difference lies in our geographical location. Newfoundland, Nova Scotia, Edward Island, New Brunswick, Quebec, Ontario and the Districts of Keewatin and Franklin we can operate in the segments 1800-1825 and 1875-1900 kHz. In the rest of the country we must use the last two segments.

Now that our new ham has received his licence and call sign, he can start to operate and put his efforts to good use. He is allowed a maximum dc input to the final of 1000 watts except on 160 meters, where he can run 375 watts during the day and 150 watts at night. The transmitter must be equivalent in stability to crystal control on any frequency below 220 MHz with sidebands not exceeding plus or minus 300 Hz. He may use any language during his QSO's, but must sign on and off in either English or French. If he wishes, he can allow another licenced ham to operate his station and a third party may speak over the transmitter

providing the licencee is present and retains physical control of the station. We have a forbidden" list of countries, which in general is slightly greater in number than in the USA and we have similar arrangements in regards to third party traffic. At the moment we can run third party traffic between Canada and the USA, Venezuela, Costa Rica, Honduras, Mexico, Chile, El Salvador, Bolivia and Peru. Our basic station licence also allows operation of one portable station and one mobile unit in a car, on board a pleasure vessel operating in Canadian territorial waters and registered under the Canada Shipping Act, or on a private aircraft. If the ship or plane is operating ouside Canadian territory limits, permission must be obtained from the master of the ship or the command pilot of the plane, and application must be made to the DOT for special permission to install and operate the station. A seperate call sign is issued. The best examples of this are the VEØ stations on board ships, with VEØN for naval ships and VEØM calls for civilian ships. All such marine or airborne stations may use the normal frequencies except no operation is permitted on 160 meters (because of possible interference to Loran navigation). Also, the band 7.0 to 7.3 MHz cannot be used outside of ITU Region 2.

You can see that we have just about the same privileges here in Canada as you have in the States except for the extra phone frequencies. Our station licences are only valid for one year and must be renewed each spring. The fee for the licence is \$2.50 per year, and to be truthful, I got quite a kick out of the furor which erupted when the FCC first proposed charging a fee for state-side licences. We have been doing this for years and years, and I doubt very much if any of us have ever begrudged this small amount of money for the year of enjoyable ham radio which we get in return.

How do we spend our hours in hamming? If you took a poll you would probably find we have just about the same proportions of DXers, traffic men, rag-chewers, etc. as in any similar group. There is a possibility that we may have more fellows using lower power and perhaps a few more using home made equipment, but remember, a great percentage of our ham gear is American-made and imported, and you know what that means! Take the price of a piece of gear in your country and add about 30% to it and that's the price we have to pay. If this

happens to be something like a KWM2 or similar item you can see how much extra it costs to put together a commercial-built station. So, like everyone else, if we can afford to buy, we buy; if not, we build, but either way we manage to keep a pretty fair percentage of our licencees on the air.

Because of the freedom of travel between Canada and the USA, a lot of W and K hams visit Canada each year and during 1967 probably still more will come to see us. With the reciprocal licencing agreement -which has been in effect for many years-American hams can come to Canada with their mobile or portable gear and enjoy their stay even more. If you would like to do so, just drop a line to the DOT, Ottawa, Ontario, and let them know your proposed time of arrival and length of stay. You'll receive the necessary forms in return and your path will be smooth sailing all the way. Try to allow a couple of weeks for the paperwork to sort itself out before you have to start out, and it's a good idea to have a record of your equipment serial numbers and proof of ownership. Get hold of some of us on the air and find out the net frequencies for the province you're going to visit as well as the operating times, and you'll enjoy checking in with the gang as you drive along. One note-you must hold at least a General ticket to get in on a reciprocal licence arrangement.

How about our numbers and organization? Well, we've about 12,000 licenced amateurs at the present time with the biggest concentration in Ontario and Quebec, which follows the population density. Every city and a great many towns have some sort of local club or association, and there are Provincial organizations such as the Nova Scotia Amateur Radio Association, Radio Society of Ontario, etc. At the moment the only national (or international) affiliation is with the ARRL which has about 4000-odd members in Canada. Canada is a vast country in physical area with a comparatively small population, so it is very difficult to weld

together a tightly-knit National group, but we're gradually working towards that end. Already some of the preliminary work is being done between the provincial groups and perhaps before long we will make the grade. In most areas there are conventions and hamfests each year, usually publicized pretty well in advance and open to anyone who wants to attend. This year we're also having the ARRL National Convention in Montreal, the first time this event has been held outside of the USA. For the July 1st weekend at least, we should have the chance to meet quite a few of you. The same weekend will feature the annual meeting of the Radio Amateur du Quebec, Inc.

Before closing, I should perhaps mention that we have a lot of very interesting awards offered for various operating achievements. Some like WAVE (Worked All VE) are well known and have been around for years, but there are quite a few more recent ones, especially some which have been inaugurated just for Centennial Year. In all cases, we've tried to make them as attractive as we can, with requirements which are tough enough to be a challenge but not so tough as to be impossible. In working for them you'll meet a lot of interesting fellows, particularly the gang in the far north. A lot of them are on some of the most isolated outposts in the world-weather stations and police posts, military sites and Eskimo villages. To them, ham radio has always been a very real link with civilization and home.

I've been asked at times if there is such a thing as a VE9. Yes, there is, but not on the ham bands. These are stations which are licenced for experimental or business purposes such as university projects and commercial point-to-point circuits, and there aren't very many of them.

This wraps up this little glimpse of ham radio here. It's by no means as complete as it could be, but the purpose is to enlighten without boring you, so if you want to know more, meet us on the air or come visit us sometime.

... VE1TG



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Suppressed-Carrier Amplitude Modulator

If you've been procrastinating about getting on sideband, why not try this simple double-sideband adapter for AM rigs.

This rig originated one day several years ago, VE6BT, Bill, was visiting with us and I was explaining this idea to him. He became enthusiastic and said, "let's build it." As I was working on my scope at the time, I drew up a diagram for the adapter designed to work with my Ranger, rounded up some parts, and Bill proceeded to build the thing in the workshop. I got the scope ready about the same time as he finished the adapter, so we were able to check its output when we got it hooked up to the Ranger and fed into a 52 ohm dummy load. The patterns were as pretty as a picture and on the air results were so good that numerous people have requested diagrams and information. VE6MM is running one at about 10 watts, VE6PZ has one on a Viking 1, and VE5GH is putting one on a TBS-50.

Development of the suppressed-carrier Amplitude Modulator requires the following:

- 1. A source of rf—the oscillator and multiplier chain in the AM rig.
- 2. A source of audio-an AM modulator.
- 3. Appropriate power supplies contained in the AM rig.
- 4. A balanced modulator.

The balanced modulator is the only item that we do not already have—so we build it as follows:

Take a look at the circuit diagram and then gather up the necessary parts. This model is suitable for use with rigs having a pair of 6L6's, 6146's or equivalent in the modulator. The parts list in **Table 1** looks impressive but the unit is very compact.

A 5" x 6" chassis will do fine. Mount the

coil centered near one end of the top plate. Mount the tube sockets symmetrically across the width of the top, leaving enough clearance for the coil. Wire the unit up, keeping leads close to the link on the tank coil, and the rf input connector close to the grids of the tubes. Use the extra octal socket to bring in the two audio leads from the modulator, filament power from the transmitter, and a ground lead.

Now it is necessary to bring out the audio and rf from the transmitter. Locate the leads from the secondary of the modulation transformer and disconnect them from the B+line and the line feeding the final. On the Viking Ranger, this is simple, as it is only necessary to pull the plug in the accessory socket on the back. Now arrange to connect the two modulation transformer secondary leads to points A and B on the adapter through the connecting cable and plug. On the Ranger I used an extra plug that fit into the accessory socket.

Set the adapter aside for a moment and take the transmitter out of its case. Locate the grid pin of the final amplifier and mount a two terminal tie point as close as possible. Disconnect the lead which feeds the rf drive to the final grid and connect this lead to one tie point. Connect the final grid to other tie points. Run two short pieces of coax from these tie points to two rf connectors on the back panel of the transmitter. Ceramic centered audio jacks are OK. Keep the coax as short as possible. Use high impedance coax, preferably an old car antenna lead-in, in order to avoid adding parallel capacity.

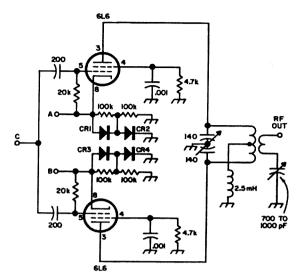
Fabricate a coax jumper lead which can be connected across the two rf connectors to distinguish them apart, as you only use the rf output connector with the adapter. Make up a coax cable to reach from the rf output jack to the rf input of the adapter.

The changes you have just made in your transmitter would be necessary if you intended to use an SSB adapter such as the SB10, so you are now also prepared for such an eventuality.

Now connect the adapter to the transmitter and connect a dummy load to the output of the adapter. Hook up your scope across the dummy load, or use a VTVM if no scope is available. The purpose is to indicate maximum output. Turn on the equipment, and after a suitable warmup period, put the transmitter on tune position. Adjust the transmitter controls to provide the desired rf drive. Feed an audio tone, preferably about 1000 Hz, into the mike input, either from some form of audio oscillator, or even a calibrator heterodyne from your receiver. Increase the rf drive in steps and raise the audio gain each time until flattopping occurs. If a light bulb load is used, the point just below maximum brightness would be the correct point of adjustment in each case. You will find that with a small amount of rf drive you can only use a small amount of audio before flattopping occurs. These amounts increase in step with one another until you reach a point where providing more rf drive will not allow you to increase the audio before flattopping occurs. You have now reached the maximum capability of the tubes in the adapter, and the correct operating point is just below this point. Set rf drive just above the point necessary to allow reaching the maximum tube point, and then reduce the audio drive to just below this so that flattopping will not occur. Now remove the audio tone and try a bit of speech. If all is well, remove the dummy load and connect up to resonant antenna. You are now on suppressed carrier AM. Have fun.

The temptation to use the centre tap on the secondary of the modulation transformer, when provided, in place of the silicon diodes, should be rejected. We found both the audio quality and the power output were much improved by using the diodes rather than the center tap.

The final tube in the transmitter is not used. In the Ranger it is protected by a



This simple suppressed carrier adapter may be used with many popular AM rigs. Points 'A' and 'B' are connected across the secondary of the modulation transformer. Point 'C' is connected to the coaxial cable which taps off rf excitation from the transmitter.

clamp tube but in any case, you should make sure that there is no plate or screen voltage applied to your final if it is not protected by clamp tubes while using the adapter.

To go back on AM, merely connect the rf jumper lead on the back of the transmitter, connect the modulator transformer secondary leads to the original connections by putting in a jumper plug or similar means. Tune up in the usual manner.

This adapter could be designed for any power level. Use a pair of tubes equivalent to those in your modulator, and be sure the PIV rating of the diodes will not be exceeded by the voltage output of the modulation transformer. Otherwise, nothing is very critical. We have two mobile transmitters under construction using this circuit and preliminary tests are very encouraging.

...VE7PQ

Parts list

- 2 6L6 tubes or equivalent.
- 3 octal sockets.
- 4 500 mA, 400 PIV silicon diodes.
- 4 100K I watt resistors.
- 2 20K I watt resistors.
- 2 4.7K I watt resistors.
- 2 .001μF ceramic capacitors.
- 3 200 pF mica capacitors.
- 1 140-0-140 dual tuning capacitor, 1000 volt spacing.
- I dual BC variable.
- I push-pull centre linked coil (B & W Baby Inductor type MCL, for band desired).
- 2 rf coax connectors.
- I 5 pin socket for coil.
- 1 2.5 mH RFC.

A Homebrew 50 Foot Tower

A tilt-over, self-supporting tower of simple construction.

Here it is—a fifty foot tower with no guy wires. It tilts over with the weight of your hand and fits into a foot and a half of space. The only thing it has not been in is a "twister"—which Canada does not have.

First of all, you need some used steel well casing. Two 20 foot sections four inches in diameter; ten feet of three inch, ten feet of two inch, and ten feet of one and a half inch. You will also need several swedges. If you do not know what a swedge is, and I did not, any pipe fitter will tell you.

Now to get the pipe. That could be a long story. It depends on whether you want to spend the money for new sections. It took me about two years of nosing around, but I finally got the pipe for a tank of gas. Then, if you can find a ham who is a welder you've got it made. The next best bet is to catch a welder in an off season.

After you get the tower welded together, set it in the ground at least six feet. Better yet, eight feet. The pipe will never break off, so set it deep in good concrete. If you are able fill the first stand of pipe with concrete—it will add to the strength—but, I really don't think it is necessary.

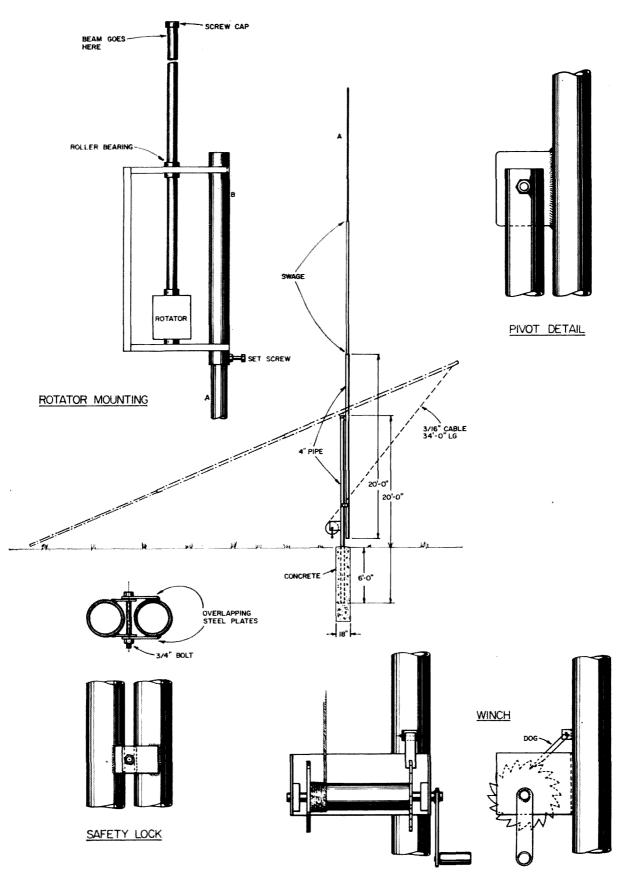
Make the hinge out of three-quarter inch steel plate and hinge it on a three-quarter inch steel bolt. Arc welding is the best and will minimize the tendency for the steel to warp. Your welder well see through the whole business in a minute. Put the hinge right at the point where the upright balances. When you put the beam, rotor and the bracket on the top, you can slide enough scrap pipe into the four inch pipe until it balances with a match stick.

The frame that holds the rotor is just a piece of pipe that slides over the last two inch pipe on the tower and is held in place with a lock nut. The roller bearing is from an old piece of machinery that will accept the 1½" pipe from the rotor. My welder made the whole frame out of steel so it weighed about 60 pounds or more. I am quite sure that you can shade that to about 30 pounds without danger of weakening the structure. Keep the top roller bearing drya graphite lubricating powder is all you need. I took a large tin funnel, cut the bottom out of it and slipped it over the 1½" mast. When it is pushed down over the roller bearing and soldered (or taped) in place, it keeps the rain, snow and ice off the bearing.

VE6GK put one of these towers up to over 70 feet. He started with 6" pipe, put the rotor on the ground and put a rod up through the whole thing to the beam. It's quite heavy but it sways very little in the wind.

The structural design and actual construction credit must go to VE6AKA. Jack is a welder by trade and he can use the torch like an artist. I would also like to thank Chester, WA7CJS/VE6, Superintendent of construction for the Fluor Corporation in Alberta, for his help and advice. What did I do? Well, somebody has to stand around and look important on any job!

VE6KS



Construction of the home-made tilt-over tower built by VE6KS. Similar models have built by other Canadian hams with heights up to 70 feet.

Mike Goldstein VEIADH 9 Edgehill Road Armdale (HFX) Nova Scotia, Canada

Simplified Transistor Design for the Ham

How to design simple transistor amplifiers with a minimum of effort.

Foreword

Over the past few years, emphasis has shifted more and more toward the application of solid-state devices in amateur equipment. Most new circuits in the ham magazines are transistorized, and many valuable tube collections and heavy power supplies gather dust while their owners scrounge transistors, diodes and small batteries. Such is progress.

For the serious builder the time usually comes when no existing designs quite satisfy what is required and he begins to think about a design of his own. This is the point where many worthwhile projects come to an abrupt halt; this is where many hams decide that transistors are just too complicated and that all solid-state designers are wizards. The procedures I propose here are satisfactory for all but the most rigorous design requirements and may be used in the design of professional as well as amateur equipment.

Information required for design

The characteristic curves of the device (transistor or diode) should be at hand before any proper design can be attempted. While some information may be available from transistor manuals or transistor testers, only manufacturer's curves describe how the device will work under any given conditions.

Manufacturers will usually supply curves upon request.

For practical thinking, an intimate knowledge of semiconductor physics serves little purpose. In terms of design, transistors are as simple as tubes. A vacuum tube is a valve, the current flowing from cathode to anode being controlled by varying the relative amplitude of the control-grid to cathode voltage. Simple. A transistor is a valve, the current flowing from emitter to collector being controlled by how much current flows into the base. Field effect transistors should be considered solid-state triodes for our simple approach—just as simple and just as adequate for design thinking.

The operation of NPN and PNP transistors is identical—only the polarities of the voltages applied to the transistor (bias) are different. Transistors are biased with the following rules in mind (see Fig. 1):

Moving the base level closer to the B minus level (by decreasing R_B) causes more base current to flow, and therefore more collector current to flow. Note that with a PNP transistor the base must be negative with respect to the emitter, and the collector must be *more* negative with respect to the emitter than the base.

The valve principle may be clearly illus-

trated by examining the collector curves for a typical transistor in **Fig. 2.** These curves could describe the operation of *either* a PNP or NPN transistor.

A constant collector-emitter voltage (V_{CE}), is chosen by drawing a vertical line through any desired V_{CE} on the scale (7 volts). Whenever this vertical line intersects with a base current curve, a horizontal line is drawn from that point to the collector-current scale.

Point $\vec{X3}$ is the point where, with a $V_{\rm CE}$ of 7 volts, a base current flow of 0.3 mA causes a collector current of 10 mA. Increasing the base current to 0.4 mA moves our operating point to XI, and causes the collector current to increase to 20 mA. Note that these curves describe the transistor operation for a given set of conditions.

Design procedures

Power output

For a safe design, use a transistor which is rated at ten times the required power output (at room temperature of 25°C). This seems extreme, but transistors are derated quite sharply (dissipation-wise) as temperature rises.

Frequency

The upper frequency limit of a transistor is usually specified as f_{hfo} or f_{β} . If the fre-

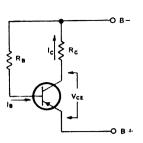


Fig. 1. Simple biasing circuit for a PNP transistor. $l_{\rm O}$ is the collector current, $l_{\rm B}$ is the base current, and $V_{\rm CE}$ is the voltage between the collector and emitter. Since $l_{\rm B}$ is much smaller than $l_{\rm C}$, the base-biasing resistor $R_{\rm B}$ is much larger than $R_{\rm C}$, the collector resistor. This circuit may be used with NPN transistors by simply changing the polarity of the supply voltages.

quency rating given is "fhrb", divide the fhrb figure by the hrb rating for the transistor to obtain fhrb. This is the point where the stage gain will be down by 3 dB (half-power point). For reliable design use a transistor whose minus 3 dB frequency is ten times the maximum frequency of operation.

Supply voltage

Most amateurs feel more at home with a positive supply voltage so let us use NPN designs. The available supply will determine the transistor. The transistor rating to con-

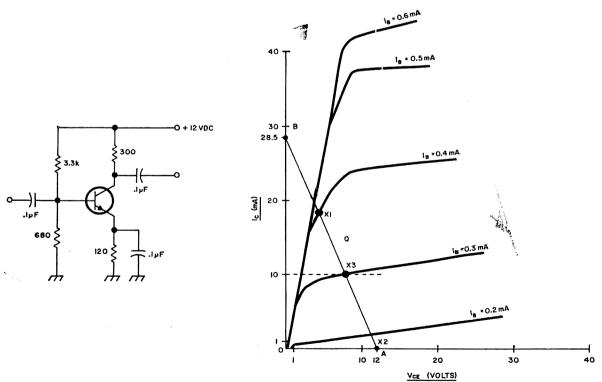


Fig. 2. A PNP transistor amplifier and its dc (static) load line. Point X3 is the quiescent point determined by the emitter-collector voltage of 7 volts. Saturation occurs at X1, cutoff at X2.

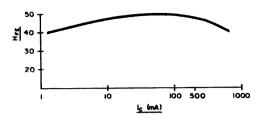


Fig. 3. Plot of the forward current gain, $H_{\rm FE}$, as a function of the collector current. The maximum $H_{\rm FE}$ of 50 coincides with $I_{\rm C}=100$ mA, but moving up or down from this point does not alter it appreciably. To maintain linearity in amplifiers, the quiescent point is chosen on a reasonably flat portion of this curve.

sider here is BV_{CEO}, the collector-emitter breakdown voltage. If the amplifier has a resonant circuit in the collector circuit, the BV_{CEO} rating should be four times the supply voltage (V_{CC})—indeed, if the stage is being modulated, the BV_{CEO} must be at least 4 V_{CC} or breakdown of the collector-emitter path may occur. These large safety factors may seem extreme, but are desirable for trouble-free designs.

Our design examples will use the 2N7388, a fictitious silicon 100 MHZ NPN transistor, rated at 0.5 watt at 25°C; $BV_{CEO} = 50$ volts and $I_{CMAX} = 1$ Amp.

Setting the operating point:

The first step in the design—once the circuit has been selected—is to set the dc operating point. This point of operation affects the gain of the stage, and determines the power drawn from the supply under nosignal conditions. The usual requirement is to obtain the most gain. In portable gear, gain may have to be sacrificed to keep power drain low, or higher-gain transistors may have to be obtained.

The choice of operating point can be made by examining the plot of h_{FE} (forward current gain) against I_0 (collector current). The h_{FE}/I_0 curve for the 2N7388 might look like Fig. 3. The procedure we will follow in choosing our operating point is as follows:

- 1. Examine the peak of the curve (maximum hre point) and see what Ic it requires.
- 2. If this current drain seems extreme, move to the left of this peak until a compromise between gain and current drain is obtained.
- 3. Try to work over a reasonably flat portion of the curve so that changes in I_c around the chosen operating point do

not affect the stage gain very much.

Choosing our operating point from the curves of Fig. 3, we see that a maximum here of 50 occurs at $I_c = 100$ mA. If we choose $I_c = 10$ mA, here is still about 45. Moving I_c either way from the 10 mA point does not change here appreciably. We will therefore set our dc operating point with no-signal input (quiescent or "Q" point) at $I_c = 10$ mA and here = 45.

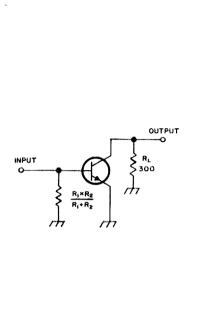
Once the operating point is set, we can quickly establish the rest of the dc conditions in our circuit by examining the plot of Ic versus V_{CE} (Fig. 4).

While looking at these curves, it would be a good idea to examine the circuit we ultimately hope to design, and how Messrs. Ohm and Murphy can combine to confuse our thinking.

The simple, basic amplifier circuit shown in Fig. 5 will work. The "practical" circuit shown is the same basic amplifier, but R_E has been added and R_E is now the parallel combination of R_L and R_E. The ac operation of the two circuits is identical, but the practical circuit is stable and reliable with changes in temperature. Let's look at the dc operation of this amplifier, with its various currents and voltage drops. To simplify things we shall assume that I_E (emitter current) is equal to I_C (collector current). We can do this without introducing significant error.

The supply voltage itself will depend on the value of load resistance required. The supply voltage must be high enough so that the IcR_L voltage drop does not approach the value of supply voltage at the quiescent operation point. This would cause the transistor to "run out of V_{CE}"—with resultant distortion. Try to arrange the IcR_L voltage drop so that it is not much greater than one-quarter the supply voltage at the operating point.

The currents and voltage drops are shown in Fig. 6. The base-emitter voltage (V_{BE}) of a conducting silicon transistor is approximately 0.7 volts, and we will assume that it is so. Ohm's law tells us that I_CR_E (drop across emitter resistor) plus I_CR_L (drop across load resistance) plus V_{CE} (collector-emitter voltage) must add up to our supply voltage. While the collector curves will only show the placement of the Q point with respect to V_{CE}, we must consider the various voltage drops when choosing the V_{CE} with respect to the supply voltage. For example, with a 6 volt supply, if we choose a V_{CE} of 5.5 volts, only 0.5 volts will appear across the



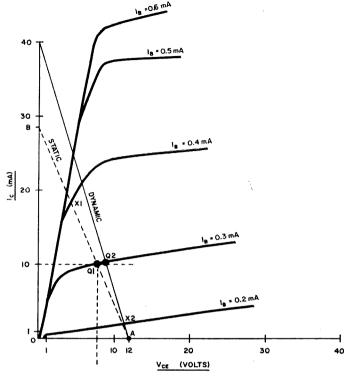


Fig. 4. Comparison of the static and dynamic load lines of a transistor amplifier. Note that going from dc to ac shifts the position of the load line. The circuit of the amplifier is shown on the left. The base-bias resistor is shown as a parallel combination of the two resistors that are actually used because this is the resistance 'seen' by the signal.

load resistance and R_E ; with a 3 k load (a practical value), the I_C would have to be less than 200 μ a. Keeping these various pitfalls in mind, let's look again at the collector curves (**Fig. 4**).

We want to place our Q point on the 10 mA I_C level (shown dotted horizontally). Let's assume a 12 volt power supply and a 300 Ω load. What value of V_{CE} do we choose to fix our Q point?

A general rule to follow is to have 1/10 the supply voltage across $R_{\rm E}$; with a 12 volt supply this leaves 10.8 volts. With 10 mA I_C, the drop across $R_{\rm L}$ is 3 volts (10 mA x 300 Ω). Our $V_{\rm CE}$ then is 12 V - (3 V + 1.2 V.) = 7.8 volts (shown dotted vertically). The point of operation of our transistor will be the intersection of the 10 mA

Ic level and the 7.8 volt V_{CB} position. Marking this intersection as Q_1 , it is seen that under these conditions our base current will be 0.3 mA. The power drawn by the transistor at the Q point (with no signal) is 7.8 V x 10 mA = .078 watts, or 78 mW. Since the 2N7388 transistor is rated at 0.5 watts, this is an adequate margin of safety.

As a check on the base current (I_B) we can use the approximation $I_B = I_C/h_{FE}$. In our case, this works out to be 0.22 mA (10 mA/45). Considering the fictitious nature of our curves, this puts us in the right ballpark. For reference at the operating Q point:

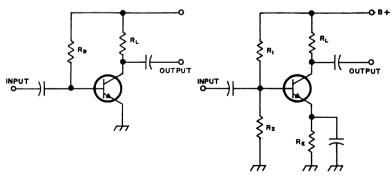
 $I_c = 10 \text{ mA}$

 $V_{CE} = 7.8 \text{ volts}$

 $P_{\text{Diss}} = V_{\text{CE}} \ I_{\text{C}} = 0.78 \ \text{watts} \ (\text{no signal})$

 $I_B = 0.3 \text{ mA}$

Fig. 5. The simple transistor circuit shown on the left will work, but the more practical circuit on the right is more stable and reliable with changes in temperature.



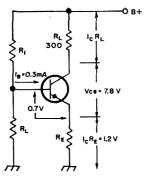


Fig. 6. The element currents and voltage drops of the transistor amplifier.

DC circuit values

Having defined the Q point, we can easily specify values for R_L , R_E , R_1 and R_2 . For clarity, let's show the known conditions on the dc circuit (Fig. 6). We specified R_L as 300 Ω . If R_L cannot be specified, use the largest value that the transistor and available supply will allow. This results in minimum loading by the following circuitry.

For stable operation with temperature changes, it is desirable to have 1/10 of V_{CC} across R_E . By Ohm's Law, $R_E = 1.2 \text{ V}/10 \text{ mA} = 120 \text{ ohms}$.

We can calculate the values of R₁ and R₂ by following a few simple rules.

A. To prevent changes in the transistor from affecting the circuit, the current through the series string of R_1 and R_2 should be at least ten times the desired base current. The current through R_1 is greater than that through R_2 by the amount of the desired base current. By Ohm's Law: $R_1 + R_2 = 12$ volts/3 mA = 4000 Ω .

B. The voltage (with respect to ground) at the base is approximately the sum of the R_E voltage drop plus the voltage across the base-emitter junction (0.7 volts).

 $V_B = (1.2V + 0.7V) = 1.9 \text{ volts.}$

C. V_B appears across R_2 , which by Ohm's Law is 1.9 volts/3 mA = 634 Ω .

D. $R_1 = 4000 - 634 \Omega = 3366 \Omega$.

E. Checking R_1 by Ohm's Law, $R_1 = (12 - 1.9 \text{ volts})/3 \text{ mA} = 3360 \Omega$. This is within 1% of our previous calculation.

The nearest standard resistor values will be quite satisfactory (680 and 3300 ohms respectively). Discrepancies between calculated currents and operating currents are caused by reading curves inaccurately, sliderule errors and variations in transistor characteristics.

AC circuit values

The capacitors used for input, output and by-passing should have a low reactance at the operating frequency. Values of 0.1 μ F to 0.01 μ F are usually suitable.

Once we have the amplifier designed, it is handy to know what it will and won't do. Back to the collector curves we go again—this time to examine the "load lines" of the amplifier (Fig. 2 and 4).

To draw the load line, the two extreme operating conditions of the amplifier must be considered.

1. No collector current at all. With no voltage drops across R_B or R_L, V_{CB} is equal to the supply voltage (point A on the curves).

2. So much collector current that the entire supply voltage appears as voltage drops across R_{E} and R_{L} , and V_{CE} is zero. This collector current is calculated by Ohm's Law:

$$I_{\text{C}} \,=\, \frac{V_{\text{CC}}}{R_{\text{L}} + R_{\text{R}}} \,=\, \frac{12 \text{ volts}}{420 \,\,\Omega} = \,28.5 \text{ mA}$$

This point is at B on the curves.

Once points A, B and Q are located on the curves, a straight line is drawn joining the three points. This is called a load line; since it was derived from the dc operating conditions, it is the dc or "static" load line.

The static load line describes the dc operation of the amplifier. For example, if we drive the amplifier with more than 0.4 mA base current, the transistor operates above point X1 on the load line, and goes into saturation. If we put in less than 0.2 mA base current, the transistor goes into a "cutoff" state. Operation must be between XI and X2. Note that if this is the case, equal changes of I_B either side of 0.3 mA produce equal changes in collector current. This is

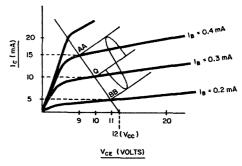


Fig. 7. Expanded view of the operating area with imposition of the base-input signal. Past the limits set by 'AA' and 'BB', the change in base current ceases to be linear and distortion will result if the signal is driven beyond these points.

the requirement for linear, distortion-free operation.

The ac or "dynamic" load line can be drawn just as easily. For ac, the bypassed R_B does not exist; the maximum collector current (ac) is now V_{CO}/R_L or 40 mA.

Note that the Q point has shifted slightly to the right along the $I_B = 0.3$ mA line, from Q1 to Q2. This slight shift in operating point can, for practical purposes, be ignored.

We now have our load lines. So what? We can obtain quite a bit of information from them. We are interested in the ac operation of our amplifier, so let's use the dynamic load line. An expanded view of the operating area is shown in Fig. 7.

First, let's check the power dissipation. From the load line we see the ac operating point sits at $I_c = 10$ mA, $V_{CB} - 10$ volts. This means a Q point dissipation of 100 mW, well within the rating of the transistor.

Next, let's mark the operating limits on our load line. These limits must be so set that equal changes in base current around the Q point (up and down the load line) produce equal changes in collector current. Past the limits shown as AA and BB in Fig. 7 this condition is not met and distortion will occur. Fig. 7 shows a sine-wave input centered about the Q point, producing the following results:

Collector current swing of 10 mA (5 mA to 15 mA)

Base current swing of 0.2 mA (0.2 mA to 0.4 mA)

Current gain is approximately 50 (10 mA/0.2 mA)

Output voltage of 2 volts peak-to-peak (9 volts to 11 volts)

Maximum power developed in the load under these conditions is (0.707 Ic peak)² x R_L. Substituting the figures from our curves:

 $P_{\text{out}} = (3.525 \text{ mA})^2 \times 300 \Omega = 3.73 \text{ mW}.$

Fig. 4 shows that in the ac circuit the bias network equivalent resistance is in parallel with the input to the transistor. The transistor input impedance is approximately equal to 26 h_{FE}/I_C (mA). The 4000 ohm equivalent resistance of the base bias network does not alter this impedance appreciably.

The *input impedance* of the circuit is about 117 ohms and the *driving power* required is approximately equal to the product of the square of the input (base) current and the input impedance

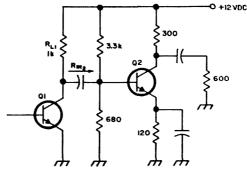


Fig. 8. To construct the ac load line of an amplifier, both the input and output circuits must be included. For example, to draw the dynamic load line of amplifier Q2, the effect of the driving transistor, Q1, and the 600 ohm load must be considered as illustrated in the text.

 $P_{in} = (I_B)^2 x Z_{in} = (0.3 \text{mA})^2 x 117 \Omega = 10 \mu \text{W}$ The power gain is P_{out}/P_{in} or 3.73/.01 = 373

Note that these results only apply if a 300 ohm ac load is presented to the transistor. If this circuit drives other circuits, a new ac load line must be drawn, and new results calculated.

With our two load lines as an example, it might be a good idea to discuss the effects of various load impedances presented to the amplifier. Fig. 2 shows the amplifier with no external circuitry attached: we saw that the dc load was 420 Ω (R_B + R_L) and the ac load was 300 Ω (R_L). What happens to the amplifer when it us used to drive another circuit?

To consider the ac loads on an amplifier, we must consider all coupling and bypass capacitors as short circuits and direct short circuits across all dc power supplies. To illustrate this, examine Fig. 8.

Fig. 8 shows the amplifier driving a 600

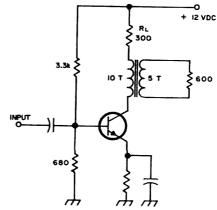


Fig. 9. Transistor amplifier with a transformer-coupled load. When constructing the dynamic load line for this amplifier, the impedance transformation ratio of the transformer must be included in the calculations.

ohm load, and being driven by another transistor, Q1.

The load on Q1 is $(R_{L1} R_{1n2})/(R_{L1} + R_{1n2})$ = (1000 + 117)/1117 = 100 ohms. A 100 ohm ac load line would be required for Q1. The ac load on Q2 is $(300 \times 600)/900$ or 200 ohms.

The ac load line must now be re-drawn, using 200 ohms as the ac load. The 300 ohm ac load has been shunted, and that load line no longer applies. The dc load line of course still holds.

Let's consider an alternative—Fig. 9 shows the amplifier coupled to the load through a transformer. Ignoring the dc resistance of the transformer winding, the dc load line remains as before. The ac load has changed drastically.

Remembering that transformers can transform voltage, current and impedance,

Primary impedance =
$$\left[\frac{\text{Pri turns}}{\text{Sec turns}}\right]^2 x \text{ Sec-}$$

ondary impedance = $\left[\frac{10}{5}\right]^2 x 600 \text{ ohms}$

= 2400 ohms
Thus the 600 ohm load is presented to the

transistor as a 2400 ohm load. In addition, the 300 ohm load resistor is in series with this, making a total ac load of 2700 ohms. By bypassing the top of the primary winding with an 0.1 μ F capacitor, we can eliminate R₂ from the ac load line.

The point which this load impedance discussion should make is that the ac load impedance presented to the transistor must be decided by the "most likely to succeed" ac load line. The load impedance this load line represents is the *total* ac load, and must include all non-bypassed bias circuits, transformer-coupled loads, and what have you. The dc circuits in the collector, and any collector transformer turns ratios must be adjusted so that the transistor sees this load impedance. In other words, the load line is first established, and *then* the output circuit is designed to present the proper load impedance.

With the information presented here it should be possible for the average ham to design simple transistor circuits at low frequencies. A treatment of high-frequency design should be covered as a separate topic, but the basic ideas and biasing methods would certainly apply.

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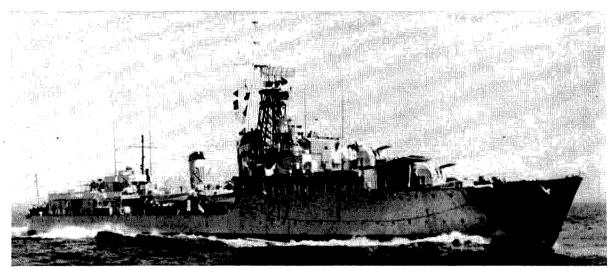
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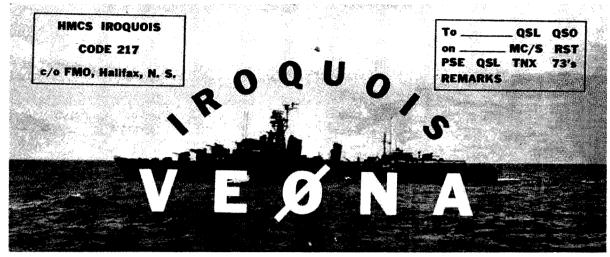
The story of the Canadian maritime mobile stations.

Have you ever worked a VEØ? Well, congratulations, for you have logged one of the rarest call signs in the world. But I wonder if you know just what you worked? "Why, sure", you say, "It was a Canadian ship", and that's true, but perhaps you'd like to know a little more about your QSO. It could have been a sleek Naval ship, or the

reincarnation of an 18th century British shipof-the-line. It might have been a ship of science or a tough deep-sea tug. Or perhaps a schooner, the replica of a legend, created with love and care in memory of a champion of yesteryear. Each one is unique, and I'd like to tell you more about them. Care to come aboard?



H.M.C.S. Iroquois, VEØNA. This was the first of the official VEØ stations. Ham activities were carried on from one of the radio rooms aboard, using the whip antenna at the rear of the ship. The Iroquois was the beginning of organized ham radio activity on Naval ships and proved so successful that other ships quickly followed suit.



Here in Nova Scotia we're never far from the sea, and I suppose we look to it much more than most people in our land. The Port of Halifax has been home base to almost all the VEØ ships at one time or another, many of the operators have been VE1's when ashore, and when at sea most of them have spent much of their time in traffic with us. So, knowing a little of the background, come along for a closer look-and perhaps, smell the tang of the sea.

Many times when a ham works a VEØ he thinks this is something new, but it isn't actually so. For many years, radio has been a most important part of any well-equipped ship, but there was little amateur operation before World War 2. It became a little more prevalent after the war, and in Canada it was the Navy which carried the ball more than anyone else. To them should go the credit for the creation of the VEØ calls.

Around late 1948, the Royal Canadian Navy began allowing ham operation aboard ship, using either personal or club calls. Although this privilege didn't last too long, stations did get into operation on HMCS Ontario, Magnificent, and Nootka. Operation was never very continuous, but it resulted

in the formation of the R.C.N. Amateur Radio Society in 1951. As a result of requests by this group and by other interested persons, the Department of Transport allocated the zone figure Ø to shipboard amateur stations, with VEØN—for Navy stations, and VEØM—for stations on government, merchant and pleasure craft.

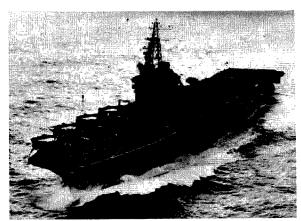
For the Navy boys, the requirements were not too difficult. Application had to be made to the Department of Transport by the senior licenced ham on board and he also had to submit an application to the Captain of the ship, who, if he agreed, would forward it through official channels to Naval Headquarters. If the application was approved, a VEØ call was assigned to the ship on behalf of HMCS (name of ship) Amateur Radio Club. The senior ham was holder of the licence and responsible for it, but any qualified ham on board could operate if the Captain approved. Only the one VEØ call could be used by all hams on the ship, and the licencee paid the regular yearly licence

The Navy then went one step further and allowed the use of only official Naval radio equipment, provided it complied with regular









H.M.C.S. Bonaventure, VEØNE. Probably the best known and most active of the Navy stations, the "Bonnie" has run hundreds upon hundreds messages and phone patches between her home base at Halifax and her cruising areas in many parts of the world. Presently undergoing a refit, the big gray lady will be back on the air again before too long.

amateur rules of operation. Over the years the Navy has contributed far more to the continuance of the VEØ calls than have any other group. The advantages have been obvious; just the boost in morale gained by contact with families at home has made it all worthwhile. When the ships are at sea, hours upon hours have been spent with traffic back home to Canada, and many of us on this coast have been on the receiving end from the start of a cruise until the day the ships enter harbour and tie up at the jetty. Like all such operations, these hours of traffic handling have had their mements of laughter and happiness, and of course there are sometimes overtones of tragedy. Still, there are few things in Amateur Radio which are more rewarding than to sit at a rig and with the flick of a few switches bring the voices of



The Canadian Scientific Ship "Baffin", VEØMJ, one of the world's most advanced ships for the study of all phases of oceanography. Because she is often on extended cruises, there is usually a good chance to work her on 20 meter CW.

loved ones to men crowded into a radio room somewhere on the high seas.

But I've digressed too much . . . let's get back to the story. After the VEØ calls came into being, the first officially licenced station was VEØNA on HMCS Iroquois, back in 1954. Aside from this distinction, the Iroquois was one of the most famous ships in the Navy. From her completion in 1942, she was always in the thick of things, sinking or assisting in the sinking of fifteen enemy ships and the damage of others, as well as tours of duty on the famous Murmansk run. To wind up her career of honour she escourted Crown Prince Olaf of Norway when he returned to Oslo from exile.

After the war, she went through alternate periods of active and reserve duty, including three tours in Korean waters, returning home in 1955. In November 1957 she was retired at Halifax, then re-commissioned and remained on the seas until Octber 1962. This was the end of her active service, and after several years of retirement she finally went the way of all ships, no matter how distinguished.

Just after the assignment of VEØNA to the Iroquois in 1954, HMCS Algonquin came on as VEØNB (the first of several ships to eventually hold this call) and on the West Coast, VEØNC was assigned to HMCS St. Stephen. All these ships operated fairly regularly on the ham bands, but the biggest effort came in 1956 when VEØND was allocated to the aircraft carrier HMCS Magnificent. The "Maggie" was involved in transporting troops to the Middle East during the Egyptian crisis, and a steady flow of traffic passed between the ship and the East Coast on each passage between the home port and the eastern Mediterranean. Probably more than any other event, these trips of Maggie pointed out the morale value of amateur radio and tightened the bonds of co-operation between the Navy and the hams back home.

In 1957, the Maggie left our service and HMCS Bonaventure took over her job. With the call sign VEØNE, the Bonnie has become one of the most active of all the Navy ships as far as ham radio is concerned. No one knows exactly how many phone patches and pieces of traffic have been passed back and forth between her crew and their families, but it must run into the thousands.

Besides the Bonnie, quite a few others are licensed at the present time-VEØNB,



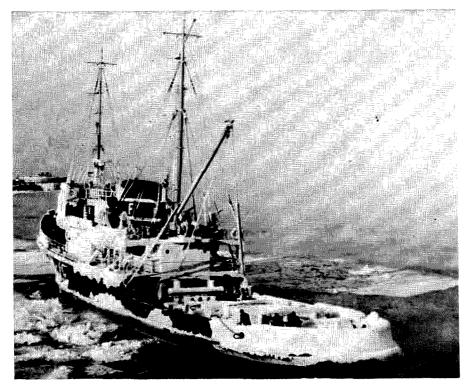
QSL card from VEØMO, HMS Bounty. Built expressly for MGM's "Mutiny on the Bounty", she is a duplicate of the famous ship on which the mutiny occurred in 1789. The "Bounty" is presently on display in Tampa Bay, Florida.

VEØNC, Gatineau; the Columbia; VEØNG, the Kootenay; VEØNI, the St. Laurent; VEØNM, the Cape Scott; VEØNU, the Terra Nova and VEØNP, the Margaree. Over the years, operation on the Navy ships has run hot and cold, but one of the most extensive uses of ham radio was during the Easter Island medical expedition of 1964-65. The Cape Scott was the transportation ship, and VEØNM ran dozens of patches back to Halifax, especially over the Christmas season. VEILZ and VEIAGH were the fellows on this end. In addition, VE3DGX set up a station on the island and operated as CEØAG, not only giving the island it's only real communication with the outside world, but also putting a new country on the air. This whole operation was a real credit to ham radio, and the Cape Scott has been in continuous operation ever since.

Since the VEØN-boys use Navy equipment, they always have been able to put out pretty good signals. Top-quality apparatus is always an asset, but more so when trying to keep phone patch and traffic schedules for weeks at a time. During the 1965-66 goodwill cruise to South America, ham operation was continuous, sometimes with two or three stations here in Halifax working together to handle the volume of traffic. One evening sticks in mind particularly, as two ships cruised along side by side off the coast of Uruguay and ran hour after hour of phone patches into Nova Scotia.

VEØ calls are all issued on a club basis, and in the order of request. No ship has any permanent call, and if operation is not maintained the call is simply passed on to another. With morale being the prime consideration, most operating time is devoted to traffic, and very little to rag-chewing. This is frustrating to a lot of people, especially since the VEØ call is quite rare, but despite their problems the boys have always managed to make up OSL cards and have tried to answer all the cards received. Like call signs, the operators change often, so perhaps some have gone astray. If you have even one such QSL, be content, for it's almost as rare as any OSL can be. Ham radio is now firmly established in the Navy, so keep listening and you'll come across them. Please, though, a word of caution-remember they are on the air for the purpose of traffic handling. Until their schedules are finished and they declare themselves open for general contacts, be the type of gentleman that every amateur should be-don't break in! Your cooperation will be appreciated.

Thus we see the Navy's story of VEØ, but what of the other ships? Let's go back in history to the British Navy of the 18th century and one of the most famous ships of all time—HMS Bounty, the ship of Captain Bligh, the subject of one of the great classic stories of the sea. When MGM Studios decided to make a movie of this story, they needed a ship, and here in Nova Scotia we



The "Foundation Vigilant", VEØMK. The "Vig" is a deep sea salvage tug, shown here coming into harbour on a bitterly cold winter day with her sides and decks heavily coated with ice. One of the toughest jobs she ever undertook is described in the text.

build pretty good ones. In Lunenburg town, in 1960, a new Bounty was built, launched and fitted out with 18th century regalia and 20th century equipment—including ham radio. With a KWM-1 and a long wire, Spud Roscoe set up VEØMO, and made many an operator happy with a QSO and later, a QSL that was a thing of beauty. The Bounty travelled the South Seas and many ports of North America, finally coming to rest as an exhibit in the waters of Tampa Bay, Florida.

The Canadian Scientific Ships Baffin and Hudson, VEØMJ and VEØMX, are the pride of the Bedford Institute of Oceanography, one of the most advanced scientific centers in Canada and a world leader in ocean research. These ships look more like luxury yachts or small cruise ships, but inside they are crammed with laboratories and the latest devices for unlocking the ocean's secrets. Their work takes them from the tropics to the Arctic and they're quite active on the ham bands. 80 and 20 meters are preferred with more CW than phone. They handle some traffic, but not as much as Navy ships, so the chances of a casual QSO are much better. Be on the lookout for them, and when your QSL arrives you'll have a souvenir of one of the most technologically advanced ships afloat.

There are several other VEØM stations

which are sporadically active. There's VEØMH and VEØMI on the icebreakers Sir William Alexander and N. B. McLean; VEØMP on the Royal Canadian Mounted Police cutter "Wood", operated by VE1RX; VEØMS, the icebreaker D'Iberville; VEØMM, a private cruiser owned by VE1ARY; and VEØMB operated by Captain Louis Romaine on the Lurcher Lightship off the south tip of Nova Scotia. This one is quite active on 75 meter phone, keeping regular schedules with friends on shore.

There's always a tale of adventure associated with any VEØ station, and any of us who have operated with them have our favorite stories and memories. My fondest thoughts are for the "Foundation Vigilant", a big, brawny ocean-going tug with the call VEØMK. In December 1964, the "Vig" left Halifax to cross the Atlantic with a huge old grain-carrier in tow, bound for the scrapvards of Bremerhaven. McWilliams was the operator, and we agreed to keep schedules each morning on their way across. The trip wasn't supposed to take more than a few weeks, but the rough old Atlantic had other ideas. As the days went by, the seas became higher, the winds stronger and progress slower. The casual morning chats soon became traffic, as the Captain and crew began letting the folks at home know the situation. Trouble developed

with the radar and we spent hours troubleshooting by 20 meter CW. After a day or two the radar was fixed and then the real storms began. Day after day of towering seas and howling gales, and then-the towline broke-and the bulk of the grain-carrier disappeared in the storm. Chasing after it, with her radio on constant watch to warn other ships of the danger of the drifting mass of steel, the Vigilant tried desperately to "hook up" again, but each attempt met with failure. Day after day I met Mick on 14.022 and hoped they had met success, and each day was the same-"No change, George, still gale force winds. Can you take some traffic?" I kept thinking, I wonder what thoughts would be going around all these homes if this schedule hadn't worked out? The ship was already overdue at her first port of call in England, and she was still only half way across. For eighteen days the gales drove the Vigilant and her wallowing target back across the Atlantic, until at last a line was secured and the long hard pull began again. Food was almost gone and fuel was low, so they headed for the Azores while we cleared every message we could before they docked. I stood by every morning for a week and a half, and one morning signals came pounding through again. Because of some problem with local communications, they had had no success in getting messages back to Canada, so that morning there was a lot of traffic on 20 meters!

Off they headed again for England, and into another succession of gales and winter storms. Christmas and New Years had come and gone, and it was the end of January, and I had become acquainted with the families of every man aboard. There's always something very wonderful about putting this amateur radio of ours to good use, and Mick and I found a lot of personal satisfaction in keeping these schedules without a hitch.

Finally, in mid-February. The Vigilant reached Falmouth, England, then up the English Channel, through the Straits of Dover and the North Sea to the River Elbe finishing the long voyage at Bremerhaven. Right to the last day, our schedules went through, and after the hulk was turned over to the scrapyards the Vigilant turned homeward. Misfortune struck again, for as she headed down the channel her Captain became seriously ill and she raced for the nearest port and hospital. Messages flew back and forth

to Canada, and his wife flew to England to be at his side. A relief Captain also flew over, and the ship headed for home with a different hand at the helm. Again the storms, but this time there was no great weight to hold her back, and she hurtled along with the wind and waves. The message total by this time was over one hundred and fifty, and every family at home knew of her day-by-day progress. On a brisk day in mid-March she finally slipped up Halifax harbour to her home berth and the arduous voyage was over—one more story to a ship whose every voyage was an adventure.

No mention of the VEØ ships would be complete without a salute to one which is a living legend. Back in the 1920's one of the largest fleets of tall schooners sailed from Lunenburg to the Grand Banks of Newfoundland. After catching as many fish as they could, the schooners spread all sails in a breakneck race for port, because the fastest schooner made the most money by getting her catch back first. Bigger and better schooners were built in the quest for speed and performance, and one of these was named "Bluenose". Hers was to be a career of achievement attained by few ships, for not only was she big, and caught a lot of fish, she was fast-so fast she could show



The schooner "Bluenose 2", VEØMY. A replica of the undefeated champion of the North Atlantic fishing fleet.

her heels to almost anything that dared try to outsail her.

It was inevitable that she be challenged to race against her competitors, and so began the famous International Schooner Races, in which Bluenose met and defeated every candidate. She was the toast of a town, a Province and a nation, but she was still a working ship. As the years went by, the tall schooners gradually succumbed to the intrusion of engines and one by one they disappeared. Bluenose kept working, but in the early 1940's she struck a reef off Haiti and swiftly slipped beneath the sea of which she was so much a part. There were black headlines and sorrow in Nova Scotia, but she lived on in memory and for many years there was talk of building a replacement-someday.

Finally the Halifax firm of Oland and Son Ltd. decided this should be done, and in the summer of 1963 Bluenose 2 was launched from the shipyard which had built her famous ancestor. In early 1964 she made her maiden voyage from Nova Scotia to Cocos Island, where a ham station was set up under the call T19FJ. On her way home, her engineer became ill and was replaced by VE1AGM. He has been with her ever since. That fall she was assigned VEØMY, and

with a KWM2 and 30L1 linear, she has become a familiar voice on the airwaves. She spends her summers cruising the waters of North America and the winters in the Caribbean. Hundreds of hams the world over have enjoyed a QSO with her. Every where she goes, she carries the pride of Nova Scotia—black hull, white sails, golden spars shining in the sunlight—the embodiment of grace and beauty.

This is, in a very brief way, something of the story of the VEØ ships. To anyone who loves ships and the sea, or has ever had the old dream of sailing away to far horizons, I hope it's been a little insight to the men and ships who put these calls on the air.

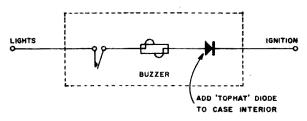
For their help and cooperation, I'd like to thank the people from Foundation Maritime Ltd., the Bedford Institute of Oceanography, the Navy's Atlantic Region Information Office, Oland and Son Ltd., R. W. McMilliams and VE1AGH, VE1AKO, VE1AX,, VE1FQ, VE1LZ, VEIPW and VE1PX. With their help and the memories of many hours in front of my own receiver, I've tried to take you aboard for just a few minutes. I hope it's been enjoyable.

. . . VE1TG

Auto Battery Saver

There are some pretty "kooky" circuits around, considering that they are often engineered for the sake of engineering rather than provide a most efficient means for doing a thing. Electronic gadgets that remind you of your headlights are in this category.

Try the one in the figure. The buzzer is a door buzzer, not a code practice buzzer whose voltage rating is too low for the purpose. The door buzzer is quite loud, too. You mobile hams won't mind building this very simple thing unless you are quite sure you never walk from your car with the lights on. Put the diode inside the buzzer case, put the whole thing in a "Baggy" to in-



sulate it, and tape it to a cable under the dash. I hate to insult your intelligence but I'll tell you how it works anyway. If you have your headlamps or parking lamps on, and the ignition switch is off, there is a 12-volt difference at the ends of the series circuit and the buzzer sounds off; the diode is happy with the arrangement. If you leave the lights on and turn on the ignition, there is 12 volts at each end of the circuit and the buzzer shuts up. If you turn off the lights and leave the ignition on, the diode prevents operation of the lights or buzzer. The thing with the 12 volts at each end is called "inhibiting"; isn't that interesting?

For the "lamps" connection, tap into any of the instrument lamps since many cars permit these to be pulled out for access. For the "ignition" connection, tap into one of the ignition switch energized loads and these are most accessible at the fuse bank. You do have a fuse bank don't you?

. . . Ray Stellhorn WAØNEA

World's Fair-1939

A look at the W2USA Radio Club at the New York World's Fair.

With Expo '67 in full swing, it's an opportune time to look at amateur radio participation at a similar event nearly thirty years ago. The W2USA Radio Club, under Managing Director W2DKJ, actually started operations in 1938, months before the New York World's Fair opened its gates. At this time operation from the fair grounds was limited to five meters—with a 400 watt phone rig and National 1-10 receiver donated to the cause by W2DKJ. The fivemeter transmissions were picked up and relayed on all the other bands by other stations.

By the time the gates were opened there

were complete stations on all bands from 160 through 5 meters. One of the high points occured on January 1, 1939, when a message from Grover Whalen, President of the New York World's Fair was put out—on the hour, every hour—for twenty-four hours on five meters. Within a short time after the first message was sent, a congratulatory reply was received from a Llama in Tibet.

The "Forty Traffic System", FTS, originated by W2LSD, handled thousands of messages from fair visitors to all parts of the world. In addition to Nils Michaelson, W2LSD, Joe Meditz, W2CKQ, Dan Lindsay,



Kay Kibling, W2HXQ, secretary of the W2USA Radio Club, mans the 80 meter CW rig. This station consisted of a transmitter supplied by the Kenyon Transformer Company and a National receiver. Although Kenyon did not manufacture transmitters, several were made especially for W2USA. To Kay's right, Dan Lindsay, W2PL, has taken over the "Forty Traffic System", using one of the transmitters and receivers supplied by the National Company. Both these fine folks, Kay and Dan, were among the most active at W2USA. We are sorry to relate that both have become silent keys.

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Many famous amateurs used the facilities at W2USA. Here Helen Leonard, W6QOG, and her husband Harry, W6MBD, of Los Angeles, are operating two of the complete stations. Helen is using the 10 meter phone station while Harry is busy at the 80 meter CW position.

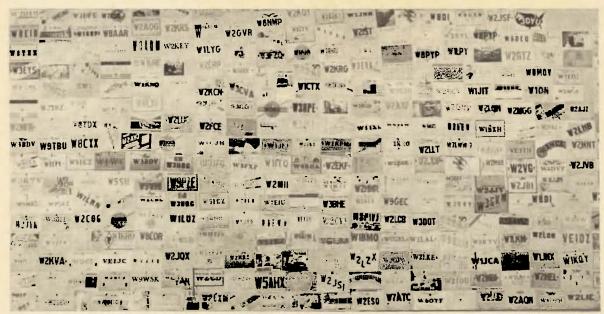
W2PL, Kay Kibling, W2HXQ and many others put in many hours running the FTS station at W2USA.

The photographs presented here were

made available through the kind assistance of Art Lynch, W4DKJ, who was Managing Director of the W2USA radio club in 1939. Other W2USA officials were Dan Lindsay,



Here Kay Kibling, W2HXQ, custodian of the W2USA license and Chief Hostess, is shown operating the 20-meter station. This position consisted of the national HRO receiver shown here and a glass-enclosed National NC-600 transmitter which is out of the picture to the left. The heavy wires running up the walls are actually the solid number 12 electric light wires used for lead-ins from the antennas, including the one on five meters. Some of these feedlines were several hundred feet long, much to the dismay of some engineers! The gentleman at the 40 meter station to Kay's right is Joe Meditz, W2CKQ.



There were more cards on this section of the wall than anywhere else in the W2USA shack—right above the 75 meter phone rig. At first the cards were displayed by district, but as the QSL's accumulated,



Actually, operation of the amateur station at the New York World's Fair began in 1938, long before the fair opened. At this time all transmissions from W2USA were sent out on five meters and picked up and relayed by other stations on all the other bands. Here Ed Dunn, W2ETD, is operating the 400 watt five-meter phone station donated by W2DKJ. Directly in front of Ed is the Hallicrafters 5-10 receiver and National speech amplifier. The five-meter antenna was an extended double Zep, designed by Frank Lester, W2AMJ, and fed with a long hunk of electric light wire. Note the great number of QSL cards from the 8th district which acknowledged the 5-meter transmissions—either direct or by relay.

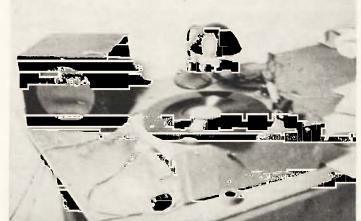


Every Friday evening at eight a broadcast of amateur radio activity at the fair, as well as throughout the country, was put out by Art Lynch, W2DKJ, Managing Director of the W2USA Radio Club. In addition to going out from all the W2USA phone transmitters at the fair grounds, it was picked up by many other stations and sent out automatically on a network which gave W2USA world-wide coverage. Six transmitters were in simultaneous use during these broadcasts as may be observed from the number of microphones. The photos in this flash-back to the W2USA operation at the New York World's Fair were made available through the kind assistance of Art, who is presently W4DKJ in Florida.



they were mounted near the equipment to which they responded. It would be interesting to know if anyone has a duplicate of one of these cards.

On New Year's Day, 1939, the famous "round-the-world round-the-clock" message from Grover Whalen, president of the New York World's Fair 1939, was put out on five meters, every hour, on the hour for twenty-four hours. Within a short time after the first message was sent, a congratulatory reply was received from a Llama priest in far-off Tibet. The original message was recorded under the personal direction of Harvey Simpson, president of Harvey Radio Corporation, with equipment loaned by him. This equipment, nearly as good as new, is presently in the archives of W4DKJ.





To the right in this photograph Bert Uthe, W2JZO, is operating the 160 meter station. Bert, who was Assistant Chief Operator and Host at W2USA, put in many hours of operating, entertaining visitors, and making some remarkable photographs. The 160 meter station—a Kenyon transmitter and RCA AR-77 receiver—was operated a large part of the time by Robert Gunderson, W2JIO, famous for his work at the New York Institute of the Blind and in providing technical information to other blind amateurs through Braille.

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George Bailey, KIKH, then Vice President, ARRL, was a frequent visitor to W2USA and always had a message for the Friday night broadcasts. Behind him "Tubby" Smith, Vice Director of the Hudson Division, watches the meters on the glass-enclosed National NC-600 20-meter transmitter. Standing are Dr. A. L. Walsh, W2BW, of the W2USA Radio Club and Dan Lindsay, W2PL.

W2PL, Assistant Manager; Oscar Oehman, W2KU, Chief Operator and Official Host; Bert Uthe, W2JZO, Assistant Chief Operator; Stanley McMinn, W2WD, Official Photographer and responsible for many of the fine photos presented here; and Kay Kibling, W2HXQ, Secretary, Chief Hostess and custodian of the W2USA license.



Nils Michaelson, W2LSD, originator of FTS, the "Forty Traffic System", is in the foreground with two of his crack operators behind him. FTS did a masterful job of handling messages from visitors to their home folks throughout this country and overseas.

Plain Ground Plane Antenna

For effectiveness and low cost, it's hard to beat the ground plane antenna.

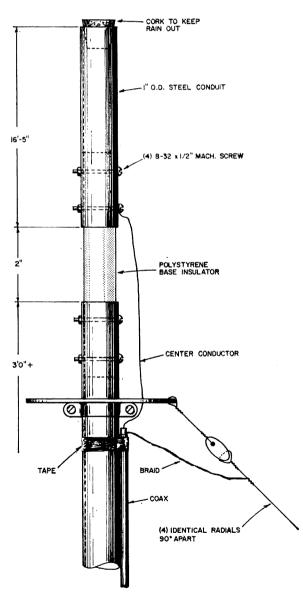


Fig. 1. Construction of the twenty-meter groundplane antenna. The polystyrene base insulator has proven to be very strong and has held up under all extremes of weather.

The tremendous number of stations now on 20 makes working DX, at best, difficult. Under these conditions, an effective antenna is a must. A rhombic is ideal if you have several empty acres out back. A 2, 3, or 4 element parasitic beam works well too if you have the time, money and patience to install it and its companion rotator. However, thanks to the ground plane, all is not lost. The ground plane is simple, inexpensive, good looking, and best of all, effective. Any of the handbooks will tell you that this effectiveness comes from the ground plane's low angle of radiation.

Probably the main reason for the lack of homebrew ground planes is the problem of insulating the vertical radiator from the support section. The insulator must provide mechanical rigidity if the ground plane is to be mounted on a standard TV mast or similar. These problems can be simply cured by insulating the support mast from the vertical radiator with a 12 inch piece of polystyrene rod. Referring to Fig. 1, this rod is inserted into both support and radiator to a depth of about 5 inches. If polystyrene rod is not available, wood doweling can be suitably varnished and substituted. Since the base of the ground plane is at a low impedance point, the wood, even when covered with condensation, will perform quite adequately. If you doubt the mechanical strength of either material, try breaking it over your knee.

Two lengths of 1 inch OD conduit were used as both the supporting section and the vertical radiator. No dimensions are given since it is a simple matter to insert the design frequency in the following formulae:

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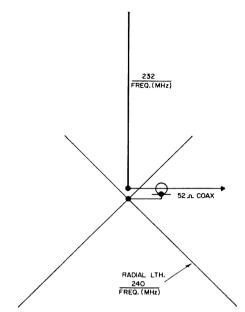


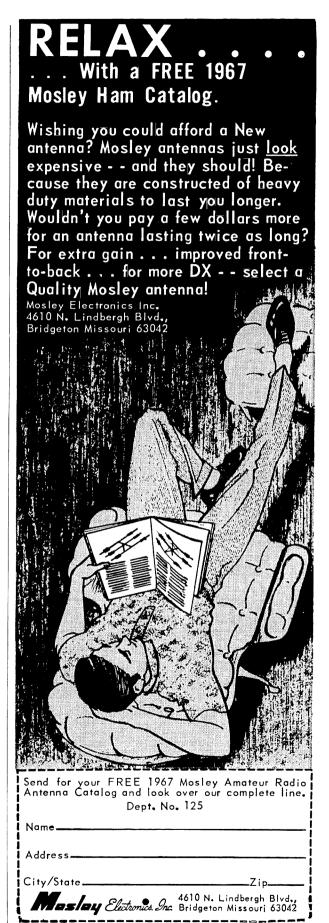
Fig. 2. Electrical layout of the ground-plane antenna. All dimensions are in feet. The match to 52 ohm coaxial line can be improved by letting the radials droop slightly.

Length of radiator
$$=\frac{232}{\text{Freq MHz}}$$

Length of radials $=\frac{240}{\text{Freq MHz}}$

All measurements from the above formulae will be in feet. While the 1 inch OD steel conduit stands approximately 17 feet unguyed, it has shown no signs of falling in winds of up to 40 mph. However, if 1 inch OD aluminum tubing were used, the weight would be considerably reduced, and consequently reduce strain on the base insulator. As far as the cost goes, the installation cannot be beat, since the entire structure, complete, except for feedline, comes to less than \$10.00. The antenna should be fed with 52 ohm coaxial cable.

Having never enjoyed the advantage of a really effective antenna at this OTH helped in evaluating this antenna. Previously a 40 meter dipole and a G5RV-multiband flattop were used with poor results, mainly on 20. However, upon completion of the ground plane, 10 new countries were quickly worked. I now have the immense pleasure of working almost every DX station that I call. Sample reports are: DU7SV 599, UA4KYA 579, VK5EH 579, and VR4CV 589. The rig here uses a single 6146 at all times, running about 90 watts. Interestingly enough, the antenna will fit the upper level of most average sized split-level dwellings. See you on 20 CW. ... VE7BBM



The Hybrid G4ZU Super-Beam

A new construction approach to the famous G4ZU three-band beam.

Any ham who has built and used the G4ZU mini—or super-beam*, knows the advantages of these antennas—cheap, light, readily tuned elements and 20-15-10 meter operation. The disadvantages—special clamps, insulators, and feeding problems.

First, a re-cap of the G4ZU element tuning principle (see Fig. 1). AB and CD are two lengths of aluminum tubing arranged in dipole fashion and insulated from each other. The lengths are such that, if B and C were joined together, AD would be a half-wave on 15 meters. The problem of electrically joining BC together, but only on 15 meters, is readily done by inserting a quarter-wave open stub across the two points. On 20 meters this stub appears as a small capacitive reactance, on 10 meters as a small inductive reactance. AD can be electrically lengthened on 20 meters by adding a small closed stub across BC and adjusting its length for resonance; this will also give (almost) a resonant fullwave length on 10 meters.

The original G4ZU mini-beam employed this method of tuning and automatically switching. A director was used as a half-wave element on 10 and 15 meters and a full-wave element on 10 meters. The driven element consisted of a 15 meter dipole,

centre fed by 300 ohm twin-lead or 450 ohm open-wire line. A special antenna coupler was inserted an electrical half-wave on 20 meters from the element and this was coax fed from the transmitter. This minibeam's performance and spacing is outlined in Table 1.

The super-beam was an attempt to improve performance on all bands, especially on 20 meters, and it certainly succeeded. It's detail is also found in Table 1 and this is the beam used for the constructional details to follow.

To construct this antenna, a twin boom is used with the quarter-wave stubs made from 300 ohm twin-lead and inserted inside the boom, centrally locating them by use of corks or plastic inserts and using the boom elements as the tuned shorting stubs, (Fig. 1). This method of stub loading works very well for the passive elements but is not suitable for the driven element. The original design used a 24' driven element fed at the centre by balanced line through an antenna coupler. This method works, but the difficulties of rotating the beam and the constant manipulation of the controls in the coupler for changes in frequency or weather led to a search for a better method. G4ZU had suggested a trap-loaded, coax-fed

*CQ, March 1957 and August 1958.

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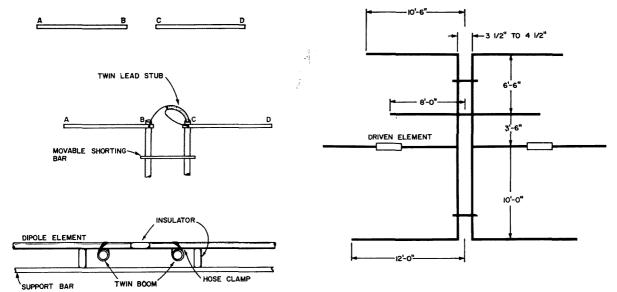


Fig. 1. Construction of the hybrid G4ZU super-beam. In this design a Moseley TA-31 trap dipole is used as the driven element.

driven element might be suitable, so one was built and tried. This idea worked but, with home-brew construction techniques, was not mechanically strong and suffered from weather effects. Digging into the catalogues provided the answer—the Moseley TA-31 trap dipole. The results obtained proved the value of this investment.

The completed beam has the configuration shown in Fig. 1. Note the extra 10 meter director. The passive elements are made from ¾" OD aluminum tubing with 24" end inserts of ¾" tubing for length adjustment. The outer tubing is notched with a hacksaw for approximately 1" and stainless steel hose clamps are used to hold the two pieces firmly together once the tuning has been completed. Large stainless steel clamps are also used to hold the passive elements to the twin boom, see Fig. 1. One clamp per element

is satisfactory (mine has withstood heavy icing and winds up to 60 mph), but two, arranged in "X" fashion will add more strength. These clamps are readily available. from auto supply houses (gear-type hose clamps, price 20 to 50 cents). The elements are reinforced with an additional 5' length of 34" tubing insulated from the element and positioned under the boom. Any good grade of plastic insulation can be used—I prefer nylon rod for its extra strength and easier working.

To attach the boom to a mast, use a piece of $\frac{1}{4}$ " aluminum plate, 8" x 8", drilled and attached to the boom by four TV U-clamps. Bolt a six inch piece of 4"×4" (or 6"×6") steel angle to the aluminum plate, using $\frac{3}{6}$ " cadmium-plated, flat-head, counter-sunk machine screws, and drill the angle bracket for two TV U-clamps so that the top of the

Mini-beam				
Band	Reflector Spacing	Director Spacing	Comparable to	
20M	0.1		2 element narrow spaced beam	
15M	0.15	0.1	3 element beam	
10M	0.2	0.15	5 element beam	
		Super-beam		
20M	0.15	0.15	3 element beam	
15M	0.2	0.2	3 element wide spaced beam	
10M	0.3	0.1	•	
		0.3	6 element wide spaced beam	

Table 1. Performance comparison between the G4ZU mini-beam and super-beam.

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supporting mast will end up against the steel angle. Plate all steel parts or give them two coats of porch enamel before assembling.

The tune-up procedure is simple. Erect a stub mast so that the beam is parallel to the ground and about 10 feet high. Feed about five watts into the antenna through a length of 52 ohm coax, and pick up the radiated energy with a field strength meter or receiver located at least 120' away. Start on 15 meters and adjust the director length for maximum output; rotate the beam 180° and adjust the reflector for minimum output. Lock the adjustable element lengths in place and check the twin-lead stubs by shorting across them when tune-up is finished—there should be no change in output. Tune the director and reflector on 20 meters by adjusting the shorting bars on the boom and lock in place. Tune the extra 10 meter director length and position for maximum output. Attach a small tuning capacitor, 50 pF, across the tri-band director and tune for maximum output.

Permanently weatherproof and install the variable capacitor or replace it with a fixed capacitor (two concentric lengths of aluminum tubing separated by polystyrene sleeving). If the additional gain and front-to-back ratio is small, forget the whole thing! Note: if more than about 20 pF must be added, recheck the director tuning on 15 and 20 meters.

Useful information; all stubs are made from 300 ohm ribbon. The director stub is resonant between 22 and 23 MHz, approximately nine feet long. The reflector stubis resonant between 19 and 20 MHz, approximately ten feet long. Shorting bar settings on the twin boom: director—30 to 40 inches; reflectors—35 to 45 inches. The twim boom uses 1½" to 2" diameter tubing with 3½" to 4½" centre-to-centre spacing. Follow the instructions given for the TA-31 dipole regarding method and type of feed and liberally coat all fittings with the liquid plastic supplied.

Two beams of this construction are in use in the Kingston area, mine and 3C3EME's. Judging from the reports and comments received over the air, the beams are performing very well. Performance on 20 meters is as good as any 3 element trap beam. On 15 meters it out-performs the trap type of beam and on 10 meters it is in a class by itself.

. . . VE3AHU

Theodora J. Cohen W9VZL/3 261 Congressional Lane—Apt. 407 Rockville, Maryland 20852

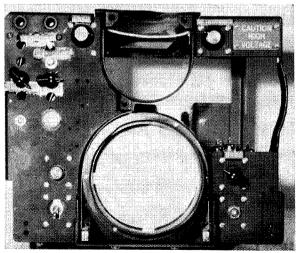
Pictures courtesy of: Capt. Thomas Polloc KH6BXS/4, NØRUH

An Economical Slow-Scan Television Monitor

The recent upsurge in slow-scan television activity presents the amateur with increased opportunities for experimentation in this mode. In addition to the Navy MARS SSTV nets (6970 kHz; 1700 EST Sunday, and 2200 EST Tuesday) and the Slow-scan Information Net (14265 or 21425 kHz, 1400 EST Saturday), twelve US amateurs are now authorized to exchange SSTV pictures with KC4USV, McMurdo Sound, Antarctica, on the 7, 14 and 21 MHz phone bands.

Perhaps the best way to enter the SSTV field is to construct a monitor. An excellent construction article for a monitor has appeared in QST^* and several amateurs have built

* "A Compact Slow-Scan TV Monitor," WA2BCW, QST, March, 1964.



Front view of W9VZL's slow-scan television monitor. For location of the controls shown in this photo, refer to Fig. 1.

this unit. However, the cost of components, as well as the trouble in locating them, has undoubtedly dissuaded many—it is for this group that this article is written. Using readily available surplus components, and following the hints given here, it is possible to construct a reduced-cost subcarrier FM monitor. And though somewhat heavy, and by no means a winner in the "looks" department, the unit, which closely follows WA2-BCW's circuit design, is capable of producing high-quality slow-scan TV pictures.

The monitor described here uses components from a PPI Range Indicator for the T-9 Tracker Radar Set An/GPG-1. This indicator, available from Fair Radio Sales, provides a wealth of components:

Punched steel chassis and front panel 5ADP7 CRT, socket, shield and mounting hardware.

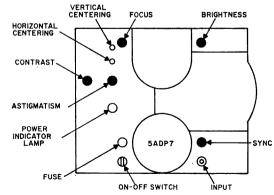
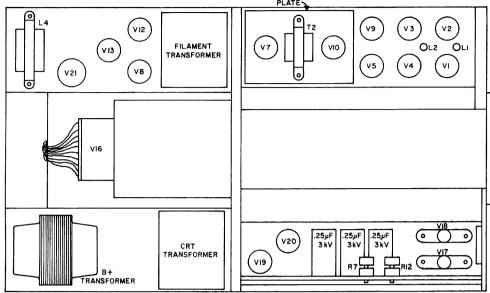


Fig. 1. Front view of the slow-scan TV monitor. This drawing shows the location of the various controls.

Fig. 2. Chassis layout of the slow-scan television monitor built from a surplus PPI Range Indicator. Existing chassis holes were used where possible.



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High voltage wire.

High voltage standoffs.

Miscellaneous machine screws, nuts, washers.

Fibre boards for buttom protection.

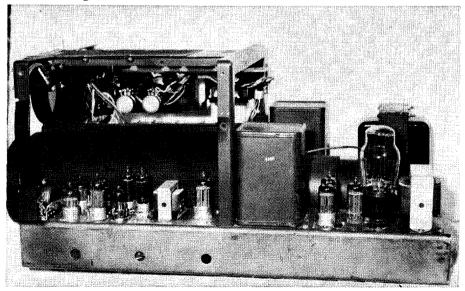
The chassis measures 13 x 11 x 24 inches and provides just enough room for construction of the monitor. When ordering the PP1

unit, it might be a good idea to include a note, cautioning Fair to check that the CRT in your indicator is the 5ADP7—about 1 in 10 of these units contains the 5SP7 CRT, which is of no use here.

No attempt is made to use any of the circuitry in the PP1; the entire unit is stripped prior to construction of the monitor. Starting on top of the chassis, carefully remove the 5ADP7 CRT and its shield. Also revove all front-panel components (save the danger plate and the small bracket which mounts behind the left side of the front panel); the 3JPI, its socket, associated gears and front-mounting hardware; all tubes; the front-most .25 μ F, 3000 volt capacitor; and

The PP1 Range Indicator for the T-9 Tracker Radar Set AN GPG-1 is available for \$24.95 plus postage from Fair Radio Sales Co., P.O. Box 1105, Lima, Ohio 45802.

Right side of the slowscan TV monitor. The limiters, sync circuitry, horizontal trigger and vertical trigger are located toward the front of the chassis. The horizontal and vertical amplifiers and video amplifier are at the rear of the chassis just in front of the 5U4G rectifier.



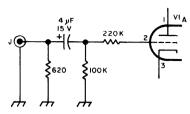
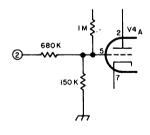


Fig. 3. This input circuit used by W9VZL eliminates the necessity for a transformer, and performs well with signals from a vidicon camera, a tape recorder or communications receiver.

the dual 6.3 Vac, 1.2 amp filament transformer (No. 7629809). Remove the two hinged subchassis which mount on either side of the indicator. Strip the subchassis which mounts over the high voltage rectifiers, and remount it. With the addition of the perforated board on the top of this subchassis, some protection from the CRT supply is afforded; additionally, this subchassis will serve as a mount for the vertical and horizontal size controls. Leave the socket for the 5ADP7 intact with sufficiently long leads for subsequent wiring.

Under the chassis, carefully remove all mounting boards, components, and hardware. Cut the high voltage wires as long as possible so that they may be used again. Once the fiber mounting boards are stripped of components (be careful not to break the soldering pins off), these boards can be remounted. All tube sockets, with the exception of the CRT HV rectifier sockets, should also be removed.

With the chassis stripped down, it can now be painted. The front and side panels on the author's unit, for example, were



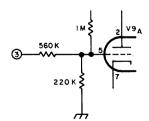


Fig. 4. Trigger input circuitry used by W9VZL in his slow-scan television monitor.



Video reception on the slow-scan monitor. This frame is of a test slide and was taken from a tape recording.

painted with *Krylon* flat black spray enamel. Make certain all parts to be painted are clean and dry. Some of the areas to be painted may require sandpapering to remove taped labels.

With the exception of circuit details described below, the circuit for the monitor is the same as that designed and described by WA2BCW. Though no unique mounting scheme exists, that shown in Fig. 1 and 2 is recommended. Following the layout shown assures maximum utilization of holes which already exist in the chassis—and with a ½ inch steel chassis, this is important. Some drilling, punching and reaming is necessary, however, so be prepared for a blister or two, as well as a dulled hole punch.

Prior to considering some circuit modifications in detail, a cross reference of major components is presented (**Table 1**). This list is included not so much in the interest of saving money, but to give the amateur a quick reference to parts he or his supplier might have. The list is not complete, and some may wish to further consult the cross reference sections of their supplier's catalogs.

Now for those circuit modifications. As the discussion proceeds, it would do well to have a copy of WA2BCW's article for reference.

Limiter and sync section

Since, in almost all cases, at least 0.1 volt of signal is available, and if one is careful to stay away from circuits carrying dc, the input transformer, T1, can be eliminated. In its place, the circuit shown in **Fig. 3** is suggested. Note that the input is now single-ended; this, however, presents no problems, whether the signal is derived from a SS vidicon camera, a tape recorder, or a com-

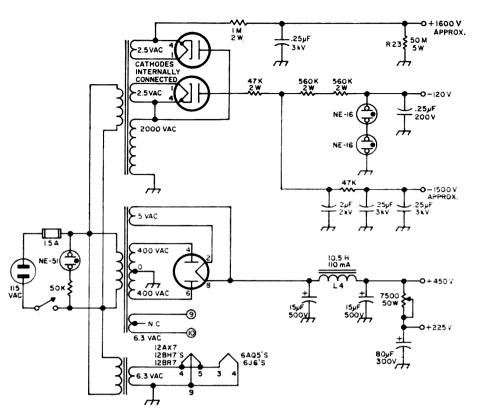


Fig. 5. Power supply for the PPI Range Indicator slow-scan television monitor. This design is based on the use of parts from the surplus unit.

munications receiver.

It is also to be noted that only LI should have its slug fully inserted (approximately 200 millihenrys); L2 should be set at about 84 millihenrys.

Vertical and horizontal deflection circuits

One of the problems encountered in operating the monitor is that of obtaining positive tracking of the trigger circuit; that is, in obtaining a range of settings for R1 (sync) over which the horizontal and vertical trigger ranges overlap. This problem could have been circumvented by using precision components, but even WA2BCW chose not to do this. Instead, the values of resistors R4 (horizontal trigger input) and R9 (vertical trigger input) were varied until proper track-

Part and WA2BCW's No.	Part Suggested	Part Used	Other	
LI, L2 45-215 mh	Stancor WC-14	Miller 6330		
L3 10 hy	Thordarson 20C52	Thordarson 20C52		
L4 10.5 hy, 110 ma	Standor C-1001	Stancor C-1001	Knight 54D2139	
TI 600 ohm line-to-grid	UTC A-12	None	Stancor WF-22 Thordarson 25A18	
T2 Audio PP plate to PP Grid; 3:1 Sec. to Pri.	Thordarson 20A19	Stancor A63C	Knight 54D1460 Thordarson 20A93	
T3, T4 Universal audio output	Thordarson 24S60	Stancor A3856	Knight 54D2023 Triad S-51X	
T5 CRT and B+	Triad R-41C	PPI CRT Xfmr and Stancor PC-8412	Thordarson 24R75 PPI CRT Xfmr and Stancor P-6143	
T6 6.3 VAC, 6 Amp. filament	Stancor P-3064	PPI Xfmr	Knight 54D2325 Thordarson 21F72	

Note: Knight numbers are from Allied's Industrial Catalog No. 670. Units shown in the "Other" column are cross-referenced equivalents; though the author has no knowledge of them ever having been used in the monitor's circuit, all should be satisfactory.

Table I. Major Component Cross Reference

put) were varied until proper tracking was obtained. Alternatively, as was done in the author's unit, pots (250 K) can be placed between pin 5 of the horizontal trigger (V4) and ground, and between pin 5 of the vertical trigger (V9) and ground, and varied until proper tracking is obtained. Then, the values of the pots should be measured and replaced with fixed ½-watt resistors. If available, a resistor decade box may be used in this step. The author's circuit is shown in Fig. 4.

The 50 meg, 2 watt resistors in the plate circuits of the discharge tubes can be made by wiring five 10 meg, ½ watt resistors in series.

Video and cathode-ray tube circuits

The less expensive and more readily available 2C6OH diode (Sarkes-Tarzian) can be substituted for the 1N1224 diode. Actually, any diode with minimum ratings of 100 piv and 50 mA average forward current should be satisfactory (i.e. 1N38, 1N39B, etc.).

Referring to the focus and brightness controls, these pots, both 1 meg, are obtained from the PP1, as are their fiber enclosures and shaft extensions. Place a 1 meg, 2 watt resistor across the terminals of the brightness control to bring the series resistance of this circuit element down to the required 500 K ohms.

Power supply circuits

Of all the circuits, the power supplies as described by WA2BCW underwent the greatest alteration. The circuit employing the PP1 transformers is shown in **Fig. 5** The CRT voltages shown are approximate; slight adjustments of series resistors may be necessary to obtain sufficient brightness. As for the B+ voltages, the 10% reduction in the author's unit had no adverse affect on operation. All .25 μ F, 3000 volt capacitors are those which came with the PP1. Large resistors, such as R23 (50 meg) and

the 1 meg, 10 watt dropping resistor were made up of combinations of other values (e.g., use two 20 meg, 2 watt and one 10 meg, 1 watt resistors in series for R23). The fuse value was changed to 1½ amp after the circuit was found to draw about 1 amp under load.

The B+ transformer is mounted to the left rear of the chassis, using but three of its mounting holes. The fourth hole is not used so as to facilitate mounting the 2 μ F, 2 kV capacitor under the chassis, beneath the transformer.

Following WA2BCW's construction suggestions and those presented in this article should allow you to construct an economical slow-scan monitor capable of producing excellent pictures. However, as with any piece of new gear, some initial adjustments are required. To aid in these adjustments, it is strongly suggested that the builder have access to a tape recording of SSTV signals. Tape recordings can be made using on-the-air transmissions simply by recording directly from the headphone jack of a communications receiver. Most any audio-type tape recorder can be used for this purpose, though to date, only capstan-drive recorders have been used (it would be interesting to see if battery-driven types with zener regulated power supplies will prove satisfactory). Recording speeds of 3\% and 7\% ips are preferred. As most SSTV signals are transmitted on ssb, care must be taken in adjusting the carrier-insertion frequency. For the initial recording, the ssb signal should be tuned to produce the most natural sounding voice reception. In making subsequent recordings, visual and aural monitoring at the same time the recording is made will enable you to make fine-tuning adjustments on the

Finally, the author would be most interested in corresponding with others who are interested in SSTV and have built, or are building, equipment for this mode.

... W9VZL/3



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FET Preamplifiers for 144 and 432 MHz

Using the 2N4416 and TIS-34 FET's.

In recent months, numerous articles have described VHF rf amplifiers using encapsulated FET's. Unfortunately, they are usually unavailable at the local electronics store. This article is about an FET that's not quite so cheap, but which is available off the shelf at any Union Carbide transistor distributor. The only drawback, if there is one, is the cost of the 2N4416. They were \$7.10 apiece in February, but since have come down to about \$5.00 each in small quantities.

The manufacturing data sheet for the 2N4416 says that it has a gain of 18 dB with a noise figure of 2 dB (maximum) at 100 MHz, tapering off to a gain of 10 dB and a NF of 4 dB (maximum) at 400 MHz. There is also a set of curves that indicates that the average 2N4416 is about 1 dB better than the specification.

Almost as soon as the development of the transistor became known to the general public around 1950, amateurs started working

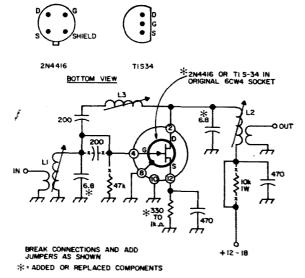


Fig. 1. Installation of the 2N4416 or TIS-34 FET in a two-meter nuvistor converter. The 330 ohm source resistor shown here is a typical value only—the correct value is determined experimentally for the proper amount of drain-to-source current and best noise figure as explained in the text.

on ways and means of pulling the tubes out of existing equipment and replacing them with these new and more efficient devices. The main difficulty was that the conventional bipolar transistor is a low impedance device and does not readily fit into circuits with inductances wound to accommodate high impedance circuits such as the grid of a pentode. The advent of the FET has changed all this.

144 MHz preamplifier

Recently two 2N4416's were obtained and plugged into an existing International Crystal 144 MHz preamplifier in place of the original nuvistor. Three simple wiring changes were actually needed and one more was added as a slight improvement.

Fig. 1 shows the International Crystal circuit with the added jumper wires. The N-channel FET can be plugged right into the nuvistor socket if care is taken to get the right leads on the transistor into the right slots in the socket. The drain goes to the nuvistor plate connection (pin 2), the gate goes to the nuvistor grid connection (pin 4), and (here is the tricky one) the source goes to the nuvistor filament connection (pin 12). The shield goes to any ground connection on the nuvistor socket.

The reason for connecting the source to the filament lead was to take advantage of the 470 pF by-pass capacitor already installed at the nuvistor socket. Now all that remains is to ground the source (old filament lead) through a suitable bias resistor. Note the use of the word "suitable". The 2N4416 data sheet says to adjust the bias to obtain a source current of 5 mA—of the 2N4416 transistors that I tried, one required 330 ohms bias and the other required 1000 ohms bias with the same 12 volt drain supply.

The manufacturer actually shows a variable voltage in series with the gate in their

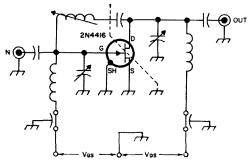


Fig. 2. 2N4416 400 MHz rf amplifier circuit recommended by Union Carbide.

experimental 400 MHz circuit (Fig. 2). Once the bias is set for the correct source current (5 mA), there appears to be no significant difference in the performance of the transistors that I have tested to date.

Referring again to Fig. 1, you will note that the following changes were made to the original circuit: short out the grid bypass capacitor, short out the 10 kilohm plate (drain) dropping resistor and add a source bias resistor (correct value determined by trial) between the old filament input terminal and ground. Clip one end of the 47 kilohm grid bias resistor loose since this will now appear directly across the old grid input coil L2 and serves no useful purpose except to lower the Q of LI. Finally, connect a source of B plus (12 to 20 volts) to the shorted-out 10 kilohm resistor with the negative to ground.

If you don't own an International Crystal preamplifier, you can build up the same circuit from scratch leaving out unnecessary parts and using a standard transistor socket. I suggest that a shield be placed across the middle of the transistor/nuvistor socket to separate the input from the output to prevent instability.

It is interesting to note that the only remaining difference between the Union Carbide test circuit (Fig. 2) and the modified nuvistor preamplifier (Fig. 1) is the relative position of the neutralizing coil L3 and the 200 pF blocking capacitor.

For some reason, all the published circuits of FET VHF preamplifiers that I have seen show the coil on the gate side of the capacitor. The nuvistor style preamplifer shows the coil on the plate (or drain) side of the capacitor as in Fig. 1. I left the neutralizing coil on the drain side of the capacitor to facilitate conversion. Neutralization was relatively easy but there is some interaction between L2 and L3. Every time you adjust one it is necessary to touch up the other.

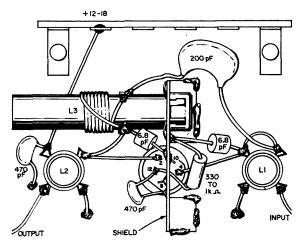


Fig. 3. Layout of the two-meter FET preamplifier.

This might be improved by moving the neutralizing coil to the other side of the blocking capacitor.

I also tried a couple of TIS-34 FET's in my converted nuvistor preamplifier and found that the gain was about the same but the noise was about one dB higher.

Any N-channel VHF FET will work in the circuit shown in Fig. 1 with only slight differences in gain and noise figure. If you use a different make of transistor, do a little checking before you make your purchase and compare manufacturer's data sheets.

432 MHz preamplifier

Since I had such good luck with the 144 MHz preamp, I decided to try a similar approach on 432. The result is both state of the art in performance and about the ultimate in simplicity at one and the same time. Because I couldn't believe what I thought I was hearing, I took the thing all the way up to Sonoma and we plugged it in ahead of Frank Jones', W6AJF, latest 432 MHz transistor converter. The result was a .9 to 1.2 dB improvement, depending

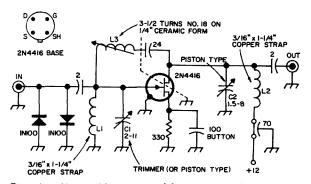


Fig. 4. 432 MHz preamplifier using the 2N4416 FET. This amplifier provides a noise figure of approximately 2.5 dB at 432 MHz with 12 dB gain.

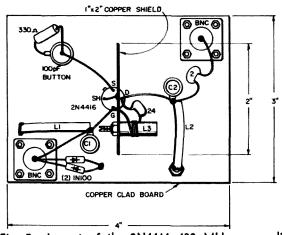


Fig. 5. Layout of the 2N4416 432 MHz preamplifier built by W6OSA. The neutralizing inductor L3 should be shown on the gate side of the shield. on which test set-up we used. To quote the maestro himself, "that's pretty good." Practically speaking, the noise figure can't be much worse than 2.5 dB.

This circuit was taken directly from the test circuit shown on Union Carbide's data sheets. The only unusual thing about the circuit is the method of impedance matching used in both the input and output circuits. This consists of a pair of 2 pF capacitors, and you can't get much simpler than that. What's more—it works.

Because I had to have a place to start, I used the inductor dimensions from Frank Jones' transistor converter in the June 1966 issue of 73. As it turned out, I had to lop ¼ inch off each one. Following the Union Carbide directions, I adjusted the drainsource current for 5 mA. This required a 330 ohm source resistor for one 2N4416 and 1k for the other one of the two I had on hand. The noise figure of the device requiring only 330 ohms bias is slightly better than the second. I don't know whether this is a universal rule, but I would be interested to hear if others experience the same effect.

Neutralizing was surprisingly easy. I started with a three turn coil and had to add another half-turn. I can now make the preamp oscillate by de-tuning the neutralizing coil, L3, to either side with the slug.

The gain of the preamp is 12 dB, plus or minus one. This is probably not enough if you are planning to run it directly into a diode mixer, but when added to the front end of an existing converter, either tube or transistor, the results are sensational. My own line up consists of a 2N4416, followed by two 6CW4's, into a 2900 hot-carrier diode mixer. Not only is the 2N4416 preamp

highly stable and nonregenerative, it had a most beneficial effect on that first 6CW4.

For those who have not worked with FET's before, here are a couple of hints. The drain to source junction is almost a dead short with zero bias between source and gate. You can confirm this with an ohmmeter not on the X1 scale, please). This is why they are normally operated with reverse bias for class A operation. The required bias is most easily obtained by putting a resistance in series with the source. This is the same idea as cathode bias in vacuum tube circuits. The amount of bias can be adjusted for best noise figure. However, the rule of thumb is to set it up for half the rated I_{DSS} (saturated drain-sourcecurrent). In the case of the 2N4416, this works out to be about 5 mA I_{DS}.

When using an FET as a mixer, the I_{DS} should be very low with no local oscillator injection—less than 1 mA. The best place for injection is the source, but this does require more local oscillator power. You will, in fact, probably need an extra transistor in your L. O. chain to get the necessary power compared to what you can get away with if you put the injection on the gate. However, bipolar transistors are pretty inexpensive these days.

Getting back to our 432 MHz preamp, the construction is simple even if you are a mechanical "drop-out" like me. I used a socket for the FET because I wanted to be able to plug in different ones. Apparently there is no need for those "zero-length" leads that we used to read about in connection with bipolar transistors on 432 MHz. The output tuning is quite sharp, the input is broad. This is why I used the high quality piston capacitor on the output and the ordinary trimmer on the input. You can use pistons in both places if you desire. I used the 70 pF feedthrough bypass capacitor because it was the first one I could find around the shack. Any value up to 500 pF should work equally well.

If you are running any kind of power on 432 MHz, like a 4X150, Frank Jones recommends using two 1N100 diodes back to back from the input connection to ground. It is pretty cheap insurance.

The ground end of the gate inductor, LI, is soldered directly to the copper circuit board base of the preamp. The ground end of the drain inductor is soldered to the top of the 70 pF feedthrough capacitor.

Any value of drain voltage from 12 to 18 volts can be used—I use a 12 V battery eliminator. I suspect that if you go much under 12 V you will start to degrade the performance. Everything else pretty much speaks for itself.

Postscript

During my experiments with these FET preamplifiers, one curious fact came to light that is worth passing on. I got to wondering what the proper bias for the TIS-34 should be, so I dug up all the past articles I could find using TIS-34's as rf amplifiers. I discovered to my amazement that out of five previous articles in 73 Magazine, the designers had used values of source bias for their rf amplifiers ranging from zero to 22k. Finally, I consulted some technical publications and learned that the rule of thumb for class A amplifiers is to use $I_{\rm Dss}/2$ (drainsource-current-saturated divided by 2), and whatever amount of bias it takes to arrive at that condition. I next conducted a little experiment with the four TIS-34's that I had on hand to see what the variations between individual FET's might be. The results of that survey are rather amazing too (see Table 1). The funny thing is that all four samples work equally well when placed in the circuit and adjusted for the proper current. The above rule of thumb does not apply to mixer applications, incidentally. In that case, the I_{DS} should be much lower, about .35 mA.

	Source			Resistance			
	TIS-34	0	100	200	300	5 00	1000
•	#1	8.5	5.8	4.9	4.0	3.8	2.2
\mathbf{I}_{DS}	#2	11.0	8.0	6.4	5.5	4.2	2.4
in	#3	5.9	4.4	3.7	3.4	2.3	1.2
mΑ	#4	16.0	11.5	8.1	6.5	4.9	3.1

I tried running one TIS-34 at zero bias and found that the I_{DSS} started out at about 8.5 mA when first turned on and drifted down to 6.5 mA after about 15 minutes. (Note that FET's draw less current as they heat up—sort of reverse thermal runaway.) In any event, I don't recommend the zero bias mode of operation. I tried grounding the source as recommended by K6HMO° and pinned the needle on my meter. My advice is to experiment until you get the best results, but start out with at least 500 ohms for the TIS-34 and 1k for the 2N4416.

* "A Low-cost FET two meter converter", K6HMO, 73 Magazine, October 1966.

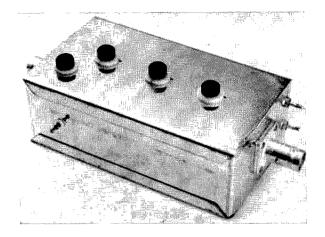


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A 30 MHz IF Strip Using Integrated Circuits

85 dB gain at 30 MHz with a 7.5 dB noise figure.

Price reductions brought about by increased production and improved manufacturing techniques have brought the use of integrated circuits within the financial grasp of every serious amateur. Most of the available units have been for digital circuits, but a new group of linear devices has been rapidly expanding. These circuits include almost all the more versatile circuits—audio amplifiers, video amplifiers, and most recently, rf amplifiers. Since these devices are often as low in price as discrete transistors, and performance is substantially better, it is advantageous to consider using them in home projects.

To see how easily the devices may be used and to provide a useful circuit application, a 30 MHz if strip was built using the Fairchild rf if amplifier, the μA03E. This device is a six-lead, epoxy, monolithic (single-chip) integrated circuit that has five transistors and two resistors connected in an emitter-coupled configuration. The amplifier can be used with transformers as interstage coupling elements; has all the biasing internally; and does not saturate for large overloads. Neutralization of the stages is not

necessary because of the very low internal feedback of the circuit. Such an amplifier could be used with existing microwave converters or radar equipment.

Fig. 1 shows the schematic of the emitter-

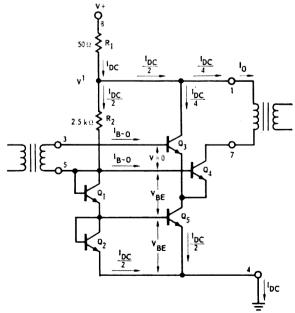


Fig. 1. Schematic diagram of the Fairchild μ A703E integrated circuit, including bias currents.

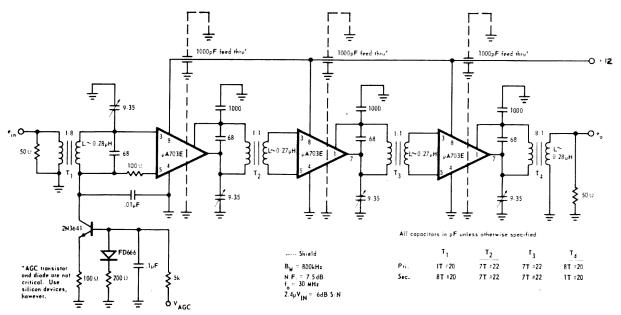


Fig. 4. Schematic diagram of the 30 MHz if amplifier. The interstage transformers are bifilar wound on cores similar to the T-37-10 cores available from Ami-Tron Associates.*

coupled amplifier and its associated bias network. The biasing of the amplifier may be understood by assuming that all parts within the circuit are well matched and the transistor current gains are high enough that the base currents can be neglected. It is also assumed that the transformer windings, particularly in the input circuit, have negligible de resistance.

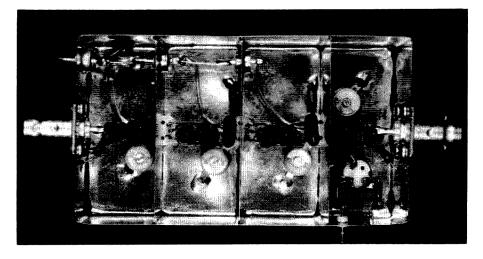
From Fig. 1 it can be seen that the current in the output transistor Q_4 , will be approximately equal to one-fourth of the supply current. Since the emitter current of Q_5 is invariable and equal to one-half the supply current, any change in collector current of Q_4 will be reflected in the collector current of Q_3 . In other words, the output current will be switched from zero to one-half the supply current. The output current,

 I_0 , is shown as a function of input voltage, V, in Fig. 2.

Quantitatively, the collector current of the biasing transistor, Q_2 , is substantially independent of the transistor characteristics and is simply a function of the supply voltage and a single resistor.

All of the transistors are assumed to be identical, hence the collector current of the current source, Q_5 , is equal to that of Q_2 because their bases are fed from a common voltage point¹. The collector current of Q_5 splits evenly between Q_3 and Q_4 with zero input signal. When the amplifier is driven, this current is alternately switched between Q_3 and Q_4 . To prevent saturation of Q_4 when the amplifier is driven with a large signal, the load resistance must be low enough that *Ami-Tron Associates, 12033 Otsego Street, North Hollywood 91607.

Below panel view of the integrated circuit 30 MHz if amplifier. Note the extensive shielding between stages and position of the toroidal interstage transformers.



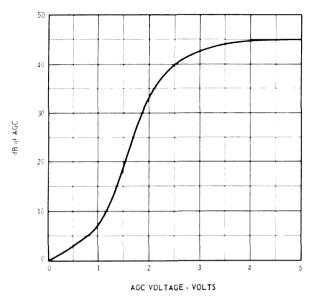
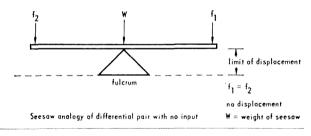


Fig. 2. AGC characteristics of the 30 MHz if amplifier.

current limiting occurs before the output voltage drops to $2V_{\rm BE}$. For a transformer coupled output, the load resistance ($R_{\rm L}$) must be less than or equal to $2R_{\rm 2}$.

This type of amplifier is referred to as

1. "Some Circuit Design Techniques for Linear Integrated Circuits", Fairchild Technical Paper #33.



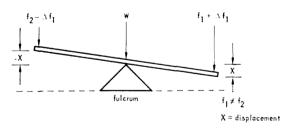
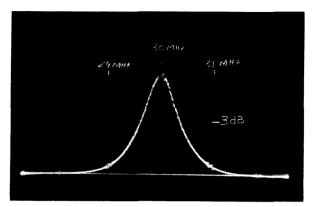


Fig. 3. Simple see-saw analogy of the differential pair with signal applied.



Frequency response of the 30 MHz if strip. The —3 dB points in the response curve result in a bandwidth of 800 kHz. With a positive 12 volt supply, this amplifier provides 85 dB gain at 30 MHz with a noise figure of 7.5 dB.

a "differential pair" and is somewhat analogous to a seesaw—if one end of the seesaw is moved, the other end moves a corresponding distance but in the opposite direction. The biasing transistor, Q_{5} acts like the fulcrum of the seesaw. (see Fig. 3).

A complete analysis of the μ A703 is available as an application note entitled "Designing with the μ A703 Monolithic RF IF Amplifier" from the applications group, Fairchild Semiconductor, Mountain View, California 94040.

Fig. 4 shows the schematic diagram of a 30 MHz if strip using the μA703E. This amplifier has a gain of approximately 85 dB, a noise figure of 7.5 dB and a bandwidth of 800 kHz. The input signal required for a 6 dB signal to noise ratio is 2.4 μV. Interstage transformers are bifilar wound on Micro-metals T44-10 cores, and have Q's of the order of 125. Placement of parts should follow the photo or be very close in order to realize the full gain of the amplifier without running into oscillation. In general, use care, and be careful, the results will be worth the effort.

The author wishes to acknowledge the effort of Dave Capella, whose patience and ability were required to build and test the amplifier.

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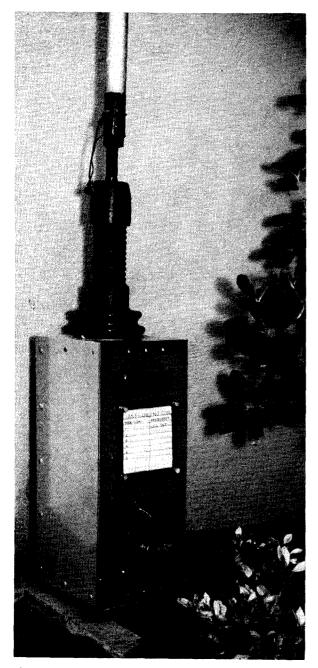
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An Un-Guyed Vertical Antenna



The base of the un-guyed vertical antenna.

Living in a flat windy location has many drawbacks—not the least of which is periodically removing the tumble weeds from antenna guy wires. I decided to experiment with a vertical antenna based on a shipboard installation I had seen. The antenna is made from three 10 ft. sections of 1½ inch plated steel TV masts. A tuning box at the bottom houses the loading coil. Total cost of the installation was about \$13.00.

The box at the base of the antenna was made from a BC-375 E tuning unit. New sides and panel were cut from 0.060 inch aluminum. A two inch hole was cut in the top for the MP-22 mast base. These mast bases are available surplus for from two to three dollars. A standard 3 inch cast iron pipe flange was mounted to the bottom with ¼ inch stove bolts.

After assembling the box the inside seams were sealed with masking tape. A three foot section of galvanized iron pipe was threaded into the flange and imbedded in concrete. Use a level to insure that the sides of the box are vertical. After the concrete has set it is very difficult to correct any tilting!

An adapter for mounting the TV masts to the MP-22 base is made from a MS-24 mast section by cutting off the male end two inches above the ferrule. Drive a wooden plug into the small diameter end of the

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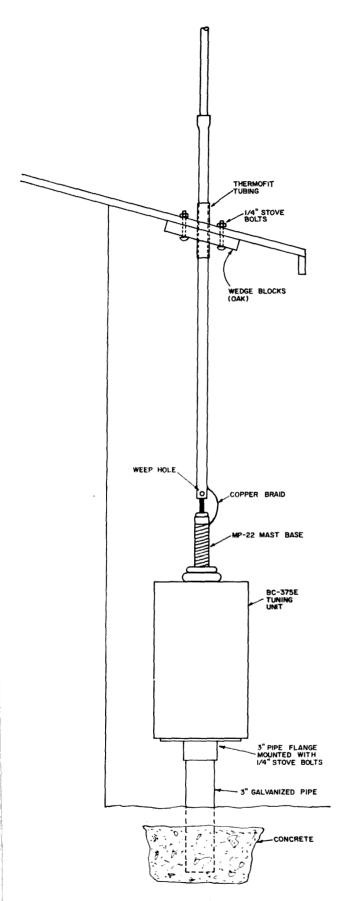


Fig. 1. The un-guyed vertical antenna.

TV mast and drill a hole through the center of the plug to accept the tubing. Drill a ¼ inch weep hole just above the wood plug.

A 1½ inch hole is bored through the eave of the roof. Assemble the low section of the antenna as shown in Fig. 1 so you can mark it where it goes through the roof. Remove it, and build up the insulated bushing using thermofit tubing shrunk on with a small propane torch.

Build up the bushing until it is at least $\frac{x}{4}$ inch thick. A length of 8 inches is adequate. The top clamp is made from a 1 x 4 x 8 inch piece of oak drilled for a snug fit over the bushing. Mount the lower section to the MP-22, then install the top clamp.

The rf connection from the TV mast to the MP-22 is a ½ inch copper braid soldered to the TV mast with a propane torch. A large copper lug is soldered to the free end for bolting to the MP-22.

The remaining sections are assembled together and dropped into the socket end of the base section. A large ground lug was installed on the base box for connecting to the station grounding system.

This antenna has been in use for over a year in a wide variety of wind conditions and shows no sign of permanent set.

. . . W6ITT

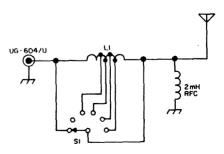


Fig. 2. Loading coil assembly. Switch S-1 is from tuning unit TU-5B. The loading coil L-1 is also from the TU-5B. The taps are set by experimentation for your own operating frequencies.

Two Cheap Crank-Knobs

As the amateur bands get more and more crowded, manufacturers of gear are decreasing the number of turns per kHz in their receivers and VFO's so that bandspread will be greater and tuning simplified. Some rigs, however, have no cranks on their main tuning knobs. One way to wear out your arm is to roam around the band looking for a contact. If you use your tuning hand for tapping out Morse, the quality of your CW won't be any better either!

Substitution with a crank-knob couldn't be simpler. Just follow the step-by-step directions and soon you'll find how effortless tuning can be! You have two choices; add a crank to an existing knob or roll your own.

Adding a crank

1. Find or buy a suitable crankless knob. Don't use the original knob if you intend to trade in your rig at a later date.

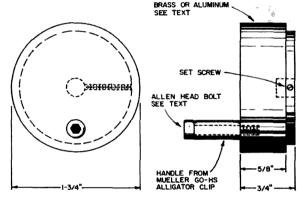
2. Get a sleeve (handle from Mueller 60-HS alligator clip, toothpaste cap, etc.) and a bolt or machine screw that fits it loosely.

3. Drill and tap a hole for the parts in step 2 on the face of the knob as shown in the diagram.

4. Assemble the parts and put them on the tuning shaft of the rig.

Rolling your own

- 1. Get a ¾" x 2" (approximate) piece of cylindrical brass or aluminum.
- 2. Turn the knob on a lathe as shown. My knob was diamond knurled for "fine" tuning. A straight knurl should do the job as well.
- 3. Get the sleeve and bolt as in the other knob.



The cheap crank-knob. To use a normal 6-12 setscrew, extend the depth of the knob slightly; the $\frac{1}{8}$ " shoulder is not quite large enough for tapping a 6-32 hole.

- 4. Drill and tap as in the other knob.
- 5. Drill a ¼" hole about ½" deep for the tuning shaft.
- 6. Drill and tap a suitable hole for the set screw. A set screw can be secured from an old knob or one can be made by cutting %" of thread from a machine screw and slotting one end with a hacksaw.
- 7. Assemble all the parts as shown in the diagram.
- 8. Put the knob on the tunning shaft.
 9. If you wish, the homebrew knob can be anodized or electroplated (plate the brass knob and anodize the aluminum one).

If you don't have the facilities, the homebrew knob and/or plating/anodizing can be done commercially. Fix a radio or TV for a machinist friend and you've got it made. One final word—happy tuning!

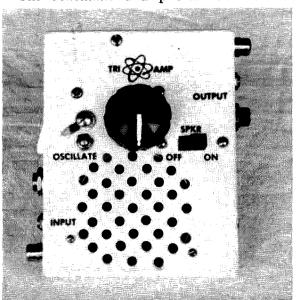
- *R. A. Kidder, "Passivating Aluminum Alloys", 73, September 1965, pages 74-80.
- **W. B. Ford, "Electroplate or Anodize your Electronics Projects", Popular Electronics, June 1965, pages 55-9, 105, Amendment—August 1965, page 8.

The Tri-Amp

A three-input, three-output, three-transistor audio amplifier with many uses

The Tri-Amp is a three-input, three-output, three-transistor unit built around a ready wired amplifier. The Tri-Amp costs less than \$8 to build from all new parts, and includes a built-in speaker, and can be used as an audio amplifier, audio signal tracer, code practice oscillator, variable frequency audio signal generator, microphone or phonograph cartridge tester, telephone amplifier, etc. Its small size, battery-operated convenience and direct connection to standard audio cable terminations makes it one of the most used instruments in the author's shack.

The schematic and photos tell most of



the story. A Lafayette Radio PK-522 Three-transistor Subminiature Audio Amplifier is the heart of the Tri-Amp. The three different types of paralleled input and output jacks (J1–J6) allow you to use common audio connectors without the bother of adapters. The potentiometer (R1) is used as a volume and frequency control, with its attached switch (S1) used to turn the battery off when not in use. Switch S2 is the oscillator keying control. Switch S3 controls the built-in speaker, and resistor R2 is a minimum "dummy load" for the output transformer when the speaker is disabled.

The author's unit was built into a convenient-sized plastic box. You may prefer to use an aluminum Minibox, a wooden cigar box or an inverted baking tin. Next decide the types of connectors you want to use; you may prefer, for example, a coaxial microphone connector in place of one of the types shown. Also, there's no reason you can't have additional types of jacks. Mount the desired jacks, being sure to wire their shells together if the box is not metal. Decide where you'll mount the potentiometer, amplifier, speaker and the two switches. Drill numerous small holes in the case to act as a speaker grille, or cut out a 2" hole and mount a grille made from screen or perforated aluminum. Mount the speaker. Mount the potentiometer and switches in the conventional manner.

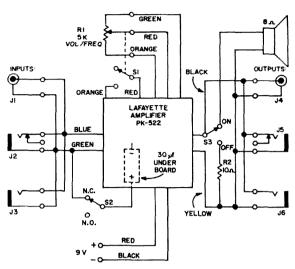
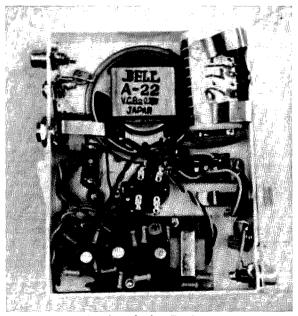


Fig. 1. Schematic of the Tri-Amp.

Now turn your attention to the amplifier. Look at the bottom of the unit. You'll find a lone 30 µF electrolytic capacitor soldered in position. This bypass capacitor is necessary to keep the unit from oscillating due to the internal battery impedance. Unsolder the positive end of this capacitor from the printed circuit board, and solder on a short lead, which goes to the common terminal of S2. The normally closed terminal of S2 is then wired to the green input wire of the amplifier, which is also wired to the input connector shells. The amplifier is mounted with three short screws and spacers, drilling small holes in the circuit board as required. The spacers may be made by cutting short lengths of metal or plastic tubing. The blue amplifier input wire goes to



Inside of the Tri-Amp

the "hot" terminals of the input jacks. The green, red, and orange wires are soldered to the potentiometer terminals, as illustrated in the PK-522 instruction sheet. The other red and orange wires go to the switch on the back of the potentiometer. The black output wire goes to the common terminal of switch S3, and to the "hot" terminals of the output jacks. The yellow output lead is then wired to the shells of all the output jacks, to a 10 ohm 1/2 watt resistor, and to one terminal of the speaker. The other end of the 10 ohm resistor is connected to the "off" side of switch S3; the "on" terminal of S3 goes to the other speaker terminal. Mount a 9 volt 2U6-type battery in a bracket made from sheet metal and connect it to the amplifier snap terminals. Put a knob on the potentiometer shaft, add panel labelling (decals or dry-transfer labels) and you are finished building the Tri-Amp.

Audio Amplifier: Normally the speaker is left "on". Turn the unit on with switch S1 on the potentiometer. The signal is connected to any of the input jacks (J1, J2 or J3) and the speaker is the output. Alternately, you can connect an ac voltmeter, oscilloscope or an external speaker to any of the output jacks; the internal speaker can be disabled by placing S3 in the "off" position. The output level is controlled by the setting of potentiometer R1.

Audio Signal Tracer: When troubleshooting an audio amplifier, the Tri-Amp, used as an amplifier, can tell you where the signal is getting stopped. Start at the front end of the "sick" amplifier, checking the grid of tube circuits, or the base of transistor circuits; go through each stage in succession. The signal strength should increase with each stage; if it decreases or disappears completely, you can look for the trouble in that stage.

Code Practice Oscillator: Turn the unft on and depress switch S2. Rotate R1 until the unit oscillates. You can control the frequency within a limited range by the setting of R1. When S2 is released, oscillation will stop. An external key can be used, but it must break contact to make the tone—just the opposite of the regular code oscillators.

Variable Frequency Signal Generator: A small solder lug may be placed near S2,

mounted so it can be swiveled over S2 to hold it depressed. With S2 depressed and RI set to the desired frequency, the output from jacks J4, J5 or J6 may be fed to any audio amplifier or modulator for troubleshooting. Start at the speaker of the "sick" unit, and work toward the front end, applying the Tri-Amp signal only to the grid or base of each stage. The Tri-Amp speaker should be disabled with switch S3. While the signal generated by the Tri-Amp is anything but a sine wave, it is nevertheless perfectly useful for this purpose.

Microphone Tester: Connect the mike to an input jack. When the Tri-Amp volume is turned up, and the mike held in the vicinity of the Tri-Amp speaker (S3 "on"), you'll get "feedback" (howling or screeching) if the mike is good. Also, you can talk into the mike and listen to the speaker to compare the strength and quality of different mikes. Remember, this little amplifier is not hi-fi, and neither is the small speaker, so don't be surprised if the microphone doesn't sound like the price you paid for it! Also, this test will not work with carbon mikes, which require excitation.

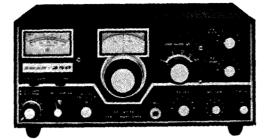
Phono Cartridge Tester: A crystal or ceramic phono cartridge has sufficient output to drive the Tri-Amp. Connect it to the input jacks (clip leads are fine) and lightly pass your finger tip over the needle(s). You'll hear your fingerprints if the cartridge is good! Some cartridges may require a full volume setting.

Telephone Amplifier: Using a suction-cup or flat type of inductive pickup attached to the telephone, the Tri-Amp will allow those around you to hear the whole conversation -especially useful for family long-distance phone calls, or business conference calls. Use the Tri-Amp as an amplifier, feeding the pickup to the input. In this use, a larger external speaker is desirable. Control the volume with R1.

You are bound to find other uses for the Tri-Amp. The author has used it as a tape recorder monitor, a low-power PA system and as a second channel amplifier for testing stereo equipment. It's inexpensive, easy to build, and much more useful than singlepurpose devices. Build the Tri-Amp and find out for yourself!

. . . K6UGT

6 METER TRANSCEIVER

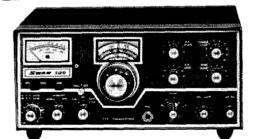


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63

Wide-range VHF/UHF Dipper

From 130 to 1300 MHz with transistors

Most dippers for amateurs that I have seen so far, not counting the \$400 ones, stop around 200 MHz just as you are about to enter the fascinating UHF region. We do have the 432 and 1296 bands, so let's become more familiar with them.

After all these years of "grid-dipping" we find ourselves without a grid; so it just becomes a "dipper". To retain the prestige of a hyphenated name we can call it a "dipper-generator". Most grid-dippers have been used as generators, but this one has built-in modulation, variable input-output coupling, controlled Q, and several other interesting features. Best of all, it goes all the way up to 1296 MHz.

When this little unit is completed it may be used as a dipper for determining the resonant frequency of VHF and UHF cir-

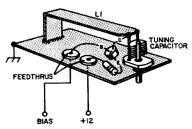


Fig. I. Basic VHF/UHF oscillator circuit.

cuits, as an indicating frequency meter with an adjustable Q-multiplier, a field strength meter and modulation monitor, a sensitive regenerative receiver, or a CW and MCW signal generator. You can also use it as a harmonic monitor or as a frequency transfer unit from one transmitter to another.

Several circuits must be considered when building a wide band instrument such as this. For example, you should change circuits around 100 MHz and again at 600 MHz, give or take a few hundred. Below 100 MHz coils are good; from there to 600 MHz you can use ¼ wave resonators, and after that the ½ wave job becomes rapidly the best method, up to 1300 MHz.

Plug-in rf heads

I have made no attempt to cover the complete range from 130 to 1300 MHz with one oscillator. By using plug-in tuners you may vary the components to suit the frequency. On 50 MHz for example, you may use a low cost transistor, a coil, and a 25 or 50 pF capacitor. From 100 to 600 MHz you use a better transistor, a ¼ wave strap, and a 10 or 15 pF capacitor. In the microwave region up to 1296 MHz you use the best transistor you've got, ½ wave lines,

and a small butterfly capacitor of 3 to 5 pF.

If you break the circuit at the right point, it simplifies things—then the two halves may be connected through a miniature 7-pin socket and plug as shown in Fig. 2. All four leads are reasonably dead to rf. You can leave out some of the audio if you like, but it's very handy to have a modulated signal. If you're running triple or quadruple conversion, it's nice to know by it's modulation which is the signal and which might be a birdie. As far as dials are concerned—it makes calibration and reading a lot easier to have only one band or range per dial.

130 to 300 MHz oscillator

Fig. 1 shows the basic % wave circuit; Fig. 2 the complete rf unit with control, af output and modulation.

The circuit itself is very simplified, as seen in Fig. 1; there being only one inductance, L1, and no choke coils. This should make for a flat tuning oscillator without power dips as it is tuned over a 2 to 1 range in frequency, and it does just that. With a 2N1726 in the circuit there is a smooth power output curve from about one volt rf at 130 MHz down to ½ volt at 300 MHz.

The rf coupling jack J1 couples the rf energy both in and out. This is because L1 acts as either a detector resonator or an oscillator resonator, as required. Actually this rf jack can be used as shown in Fig. 2. P1 is a variable link to L1 and is plugged into J1; J1A has a few inches of cable between the white ABS plastic front panel and the copper clad bakelite sub-panel. Because the phono plug is rotatable, a nice variation in rf coupling can be obtained. The coax cable and J1B get the rf out to the front panel for easy use with antennas, probes, cables, etc.

The emitter goes to a 1K resistor then through a coaxial bypass capacitor which gets the dc in and out and leaves the rf behind. These feed-through type bypasses are very necessary—do not skimp on this item.

300 to 600 MHz unit

Fig. 3 shows that this unit is essentially the same as the last, except for dimensions. 1 used a 2N1141 here although many others

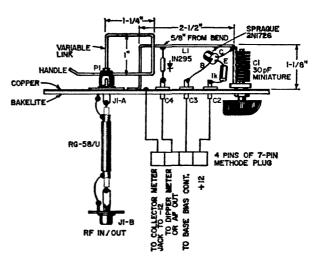


Fig. 2. 130 to 300 MHz tuning head.

will work too. It tunes smoothly from 300 to 600 MHz; use the variable link feature as in Fig. 2.

900 to 1100 MHz

For this frequency range we need a little different approach. From Fig. 4 we can see that we now have two ½ wave lines on which low-voltage points can be found to attach the base and collector resistors. Most of the ¼ wave portion of the lines on the transistor end are actually inside the case. The places where the base resistor and the 500 ohm collector resistor are attached to the ¼ wave lines can be found, or checked, by watching the rf meter and touching the lines with a pencil. At the proper point no change occurs in the rf output; sometimes it even increases.

The diode circuit of Fig. 6 is not ideal but it works. I have several of these around

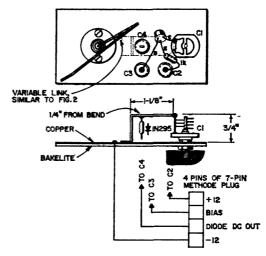


Fig. 3. 300 to 600 MHz oscillator with variable link.

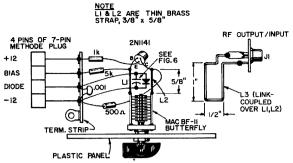


Fig. 4. 900 to 1120 MHz oscillator circuit.

the shack and they work very well for detecting 1296 Mhz energy. Even ordinary hook-up wire will support the assembly of Fig. 6 about ¼ inch below the rf lines; you will soon find the best spot with the unit oscillating. The rf input jack and associated loop L3 are fastened so that L3 is in place over LI and L2, and it's coupling can be varied in a semi-fixed fashion.

At this point we should mention that as a "dipper" the circuit is still working fine; also as a signal generator. It also serves as an rf detector but as the frequency gets up into the microwave ranges it is not quite as good as the tuned rf detectors featured in another article in 73 Magazine. Ideally, you should use the dipper on microwaves as a modulated generator and couple it into the unknown circuit; then a probe attached to another tuned detector should be coupled into the unknown circuit. There are quite a few variations using the dipper as an oscillator that you will find useful if you use a little ingenuity.

In the microwave detector line, my experience indicates that the plunger tuned coax cavity line is the best, the tuned trough line next, and the circuit of Fig. 5 next best. As a dipper, generator and regenerative receiver it is still good at 1296 MHz. Just to check, I plugged an antenna into J1, put an audio amplifier across the diode and copied a small transistor oscillator across the room. The base bias control works as a very smooth regeneration control. Smooth regeneration, as we will see later, is very important for maximum sensitivity when looking for harmonics and weak signals.

1200 to 1300 MHz unit

Fig. 5 shows the 1296 unit; I have used this circuit for many months as a dipper, variable-frequency generator, modulated-

oscillator source, and as a regenerative receiver for 1296. In this circuit I used a negative dc grounded collector return. Don't short the base plate to the modulator base. Note that one end of the diode is tied to the base plate; this lead is brought out as the minus 12 volt lead. You can also use it ungrounded as in Fig. 4—you can use a 5th lead in the 7-pin plug and keep the diode isolated from the minus 12 volts. Suit yourself, just remember that all units have to use the same leads, as they all plug into the single modulator rf unit.

I just plugged a little 12 element Yagi antenna into this dipper and it works nice and smooth as a regenerative receiver. Please note, this is only for test purposes around the shack. You can hear with it, but not *that* good!

I had to put a choke in the cathode lead on this one, and tune it (the choke) with a piece of copper foil. A choke was needed in the collector lead too; after all this is the L-band microwave region.

The rf input jack J1 is mounted on a bakelite upright. Be careful of vertical metal pieces attached to the base plate; they only need to be two inches long or so to become Marconi antennas on 1296! Bring the base resistor and the collector choke away from the lines in a perpendicular fashion—it helps.

The total length of the diode and it's two leads, from ground to the tiny .001 capacitor C2 is about 1½ inches; it is spaced about 3/16 from the ground plane. The bottom edges of the lines are about ½ inch

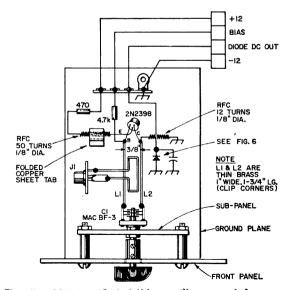


Fig. 5. 1200 to 1300 MHz oscillator and layout.

from the ground plane.

The transistor presently in the unit is a selected 2N2398; about half of the dozen or so I have here go to 1300 MHz, a couple go to 1400, and the rest to 1100 or 1200.

Don't be alarmed that LI and L2 are longer than those of Fig. 5, the smaller butterfly capacitor does that. You can make a choice as to capacity, length of brass, and desired rf range. You can use a 5 or 10 pF capacitor for CI, shorter lines, and tune over 1300 MHz. In fact, I have reached 1600 MHz with this circuit!

Modulation and control

Fig. 7 shows the circuitry for bias control, modulation and audio. Don't let it scare you. It's just the same old deal of doing what has to be done for control purposes, and from then on just turning the knobs to get what you want.

I have found that a very good plug and jack can be made by using an ordinary 7 pin socket and a Methode 7 pin bakelite plug. Unfortunately, I have never found a miniature tube with a bakelite base; they are always made of glass, so you will probably have to buy the 7 pin plug.

The minus 12 volt lead goes to the collector meter jack and then to the minus 12 volt of the power supply. This puts the rf panel ground at minus 12 volts and the audio af panel at plus 12. Of course, you don't have to ground the plus 12 on the audio panel, I just have that habit.

The base return goes through a 5K resistor and then to the bias control potentiometer. The diode dc/af output goes to af jack J2 and the meter M1 through the meter sensitivity control. This potentiometer is selected to suit the meter; I have used a 10 K unit with a 500 microampere meter. Note that part of this resistor should be used when af output is desired, otherwise the meter shorts out the af.

Audio modulation

You might think that just about everyone knows how to build an audio oscillator. Mine did oscillate, but the tone! And the wave-shapes, hoo-boy! I used an af transformer with the collector on one side and the base on the other. So, once again to the handbooks and once again practically zilch. I did get the idea for a phase shift oscillator out of one of them, even if the



Fig. 6. RF detection loop for half-wave oscillators.

circuit didn't work at first. After considerable experimentation I can recommend the circuit shown in Fig. 7. It works! In addition, the modulation may be adjusted to exactly 1000 MHz. This is very useful as many microwave test amplifiers have built-in narrow band af audio filters centered on 1 KHz. There is also a modulation gain control. This helps if a nice tone is desired.

Almost any small transistor output transformer will do the job for the af transformer, but don't go over 400 ohms impedance in the collector winding. Note the IK resistor between the collector and the phase shift network; this reduces feedback to the base and may have to be increased or decreased depending on the gain of your transistor at 1000 Hertz.

I usually run the rf current (collector dc) between one and two mils with the 2N1726 transistors; other transistors may take more. A number 48 bulb in the collector lead may save you a \$3 transistor. With the 2N1141 the rf output keeps climbing up to 4 or 5 mA collector current. You will readily find the best place to operate. When the collector mils keep climbing and the rf output starts to drop off, back off!

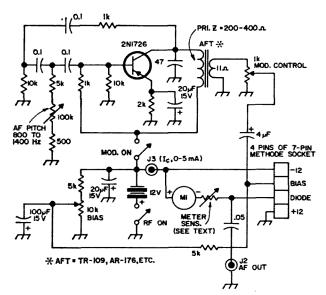


Fig. 7. Power control, modulation and audio circuitry. This circuit is used with all the rf heads.

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Operation

Dipper

As a general rule "dipping" is easier in the VHF region and gets more difficult as you go into the microwave region. On HF you couple one coil end on to the other; on VHF you bring it near, and on UHF you have to work to get the necessary coupling or use a probe.

With nothing near the dipper, swing the dial through the range to make sure it has no dips of it's own. The VHF/UHF units without chokes described here do not generally have such dips. Unwanted dips can be caused by chokes, resonant feed wire lengths, metal supports, and rf links and cables among other things.

When you do get a dip after coupling to the unknown circuit be sure and change the resonance of that circuit for a final check while watching the dipper meter. If the test circuit is a tuned circuit vary the tuning and see if the dipper will follow it—it should. If all else fails, use the dipper as a generator. Since it is very difficult to get the far end of a cable matched exactly over much of a frequency range, expect to find external dips in the dipper when using a cable.

Indicating frequency meter

Always keep the transistor plugged in and the base bias at zero so the diode is doing the work. When you advance the bias, collector capacity will cause the dipper frequency to change a little—more with some transistors than others.

For finding a weak signal you can use regeneration by turning up the base bias, but watch out for slight frequency changes. This regeneration can be very handy for finding weak oscillators or hard-to-find rf energy. Use the rf input loop with care; the least coupling is the best. Remember that some cables and terminations will detune L1.

Field strength meter and modulation monitor

The first part is obvious; use a small antenna or probe, get some signal in, and go ahead. Do not use any base bias to start with. If you are working with a very weak signal you might have to push the bias up for regeneration.

The modulation monitor is simply our

often-described system of diode detector, transistor amplifier, and padded ear-phones. You can actually hear what your own transmitter sounds like to others. I use it on every new rig and after every circuit change. You don't need much of an antenna or probe when listening to your own rig; don't overload the diode when checking modulation. In fact, use light rf coupling and plenty of audio gain to hear yourself as others hear you.

Regenerative Receiver

Plug an audio amplifier into J2, Fig. 7, advance the bias control, and tune. I have heard several UHF TV stations from Massachusetts up here in Peterborough, so it is really sensitive. One nice feature of this circuit is that the regeneration turns into oscillation very smoothly. Stability is good too. You can heterodyne a crystal controlled two meter signal and copy CW with it. Not bad for a 144 MHz blooper!

To transfer signals from one transmitter (A) to another (B), just tune in A, then shut it off; listen for B and tune it in. That's all. Harmonic monitoring is easy; just tune over the suspected range in the regenerative condition. It is particularly good because only one frequency is present in the receiver. This is not the case when using a super-het receiver for monitoring harmonics.

Signal generator

One of the big features of this circuit is the presence of an rf meter right in the proper place circuit-wise. The modulation also helps, especially when running triple or quadruple conversion in a receiver. The modulation control is very convenient, at full on its spreads the signal across 20 or 30 kHz on a selective receiver. For checking a difficult to get at circuit, use a cable and probe, either capacitive or inductive, to get the signal into the unknown circuit.

I often use one of these units for antenna and receiver tests. I just plug a little two element beam into the rf jack and set it out away from the shack; often one or two hundred yards away. There is nothing like tuning up pre-amps with your antenna system connected. For antenna tests it is used in reverse.

These are most of the uses that I have found for these dippers; if you can find any more, let me know. . . . KICLL



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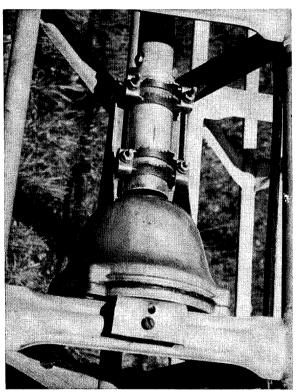
A Few Tower Hints

to improve your antenna installation

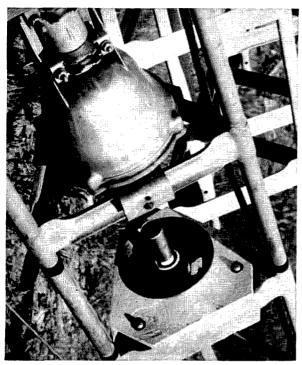
If you are troubled with freezing and rusty rotators, sticky masts or damaged cables at the top of your tower, this neat solution by Ted Woolner WA1ABP may be helpful. Ted has included just about everything but the kitchen sink in this installation to make sure that the rotator and wiring stay high and dry during all types of inclimate weather. With this type

Here's the top of the mast with a piece of \(\frac{5}{8} \) Inch copper water tubing through which the coax passes from the driven element, down through the mast to the rotator with slack left, then is taped to the side of the tower.

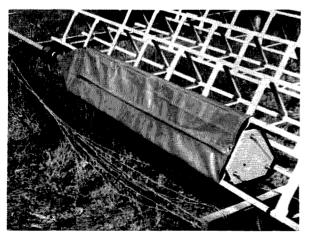
of protection, almost no moisture can get into the rotating parts, the control wiring doesn't corrode and the coax stays dry. What little



I used one and one-half inch electric conduit for the mast and found that for it to run true through the tower top, it was necessary to have a piece of aluminum machined to fit inside the mast where I bolted it in two places at 90 degrees. I found that the right size aluminum to use on my AR22 rotator was 2-1/16 inches in diameter and not 1½ inches as suggested by C.D.R.



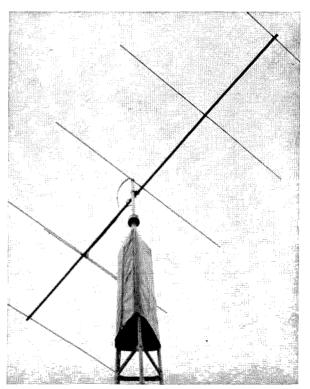
Here is an electrical heating unit made by the Wiegand Co., 7500 Thomas Blvd., Pittsburgh, Pa. It is called the Chromalex and operates from 115 V ac at 150 watts. It uses a standard screw base and is best mounted in a porcelain socket. The power line can be the outdoor plastic-insulated Romex normally used for outdoor lamps, etc. Inside the shack, an electric light bulb can be placed in series with one leg for cutting down on the amount of heat and a fuse could be placed in the other line. A fuse in each line would give full heat at the unit.



This is the nice wind, rain, and ice-proof tent or glove I had made by the Rayco Automobile Top Co., here in Shrewsbury. It is equipped with a full-length zipper to allow work or removal of the rotator. It fits the top of the tower snugly and is taped to further insure that water does not leak inside, though it can't since the copper shield is over the top of it. At the time these photos were taken, I had not installed the eyelets at the bottom of the hood, where it will be tied in with shoe laces.



A copper umbrella that is made to fit snugly over the top of the mast keeps water and ice out of the top bearing of the tower. It is held in place with an automobile radiator clamp and taped as well.



Here's the whole tower installation.

condensation there may be is taken care of by the built-in heater; Ted has thought of just about everything in his *Tower of Babylon*—1966. The photos tell the whole story.

... WAIABP

Monitoring with an Oscilloscope

Do you own an oscilloscope? Do you use it to monitor your transmitter? One of the questions I hear most often follows the lines of "I've got a Fuzzyline Oscilloscope Mark II; how can I use it to monitor my transmitter?" This is a good question, but the answer isn't too easy because it depends on what you want to see.

Basically, there are two types of pictures that an oscilloscope can show of your transmitted signal and two types with a received signal. The first, and easiest to obtain, is the *envelope* pattern, so called because it shows the limits of rf voltage with all changes in amplitude. The second, and harder to get pattern, is the trapezoid (AM) or *bow-tie* (SSB), which shows the relationship between modulation voltage and carrier voltage. Fig. 7 shows examples of these patterns (see 73 Magazine for July, 1963, page 80 for more typical patterns). When the oscilloscope is connected to a receiver, it may be used to obtain a display that fol-

lows an amplitude to radio frequency relationship.

The envelope pattern shows how much rf your transmitter is putting out, what audio signals are doing the modulating, the percentage of modulation, and any hum, noise, or distortion. It's not very useful for SSB. The trapezoid, or bow-tie pattern, tells you nothing of your audio wave forms; it just shows the relationship between the af and rf voltages, modulation percentage, and the modulation capability of your transmitter. It can also tell you if your transmitter is tuned properly or if it is a faulty design not capable of good modulation.

The panadapter display obtained with receivers shows a portion of the frequency spectrum horizontally and signal strength vertically. It displays nearby signals, sidebands, and can provide approximate readings of modulation percentage.

Obtaining the envelope pattern is easy with nearly all oscilloscopes, but few will give

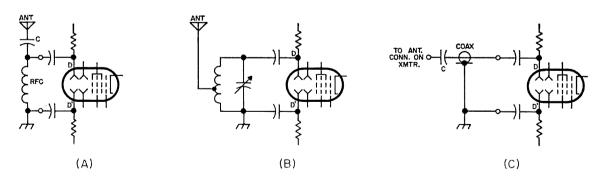


Fig. 1. Methods of connecting directly to the deflection plates of the oscilloscope. The value of the coupling capacitor C should be adjusted for proper pattern size. The deflection plates are indicated by D and D'; the resistors and capacitors associated with these plates are for isolation and are usually built into the instrument.

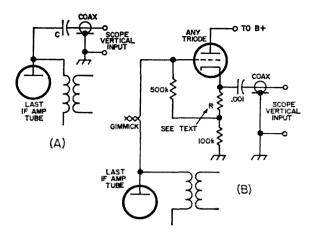


Fig. 2 Connecting the oscilloscope to a receiver for monitoring purposes. In A the coax cable should be as short as possible and permanently connected into the receiver. The triode cathode follower shown in B effectively isolates the receiver if stages from any loading due to the cable into the scope.

the trapezoid without some added work. Practically all scopes provide direct connection to the vertical deflection plates and a sweep voltage for the horizontal plates. If we feed some of the transmitter rf directly to the vertical plates and set the horizontal sweep for full screen width, we have our envelope pattern! Where do we get the rf? There are various ways to pick up the necessary rf, but the arrangement in Fig. 1A is the easiest. If the capacitor C can be readjusted for pattern size when changing bands, this is an all-band circuit. However, if the antenna is very long, you may find yourself monitoring a neighbor's CB transmitter! Fig. IB solves this problem by using a tuned circuit instead of an rf choke-it requires less pick-up antenna and pattern size can be adjusted by tuning-but, it is a one-band affair. RF for the circuits of Fig. 1A and IB may also be obtained by loosely coupling the pickup wire to an antenna tuner. Do not try to get the rf from the transmitter tank circuit-it is dangerous and may cause problems with TVI.

Fig. 1C shows a direct pickup from the feedline. This is more difficult and low-power transmitters (under 75 watts) may not have enough rf for a good size pattern. For high power the size of the coupling capacitor must be determined by experiment. The blocking capacitors shown in Fig. 1 isolate centering voltages present on the deflecting plates from the rf pickup circuits. They are usually included in the oscilloscope—if not, add them.

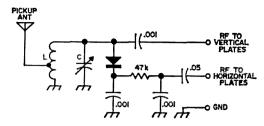


Fig. 3. This circuit provides a trapezoid pattern without any direct connections to the transmitter. However, it has several serious limitations as noted in the text.

Any good commercial oscilloscope may be used with a receiver to obtain an envelope display, provided the vertical amplifier frequency response includes the receiver's if frequency. The necessary connection to the receiver is shown in Fig. 2A. The value of the capacitor C should be as small as possible to give a readable pattern on the screen. If it is much larger than 10 pF the if circuits must be re-aligned. A much better scheme is shown in Fig. 2B, but it requires the addition of an extra triode to the receiver. With the cathodefollower output the shielded wire to the scope can be fairly long and the circuit has a negligible effect on the if stage. The cathode resistor depends on the tube type used and should provide normal class A bias; the gimmick coupling capacitor is just large enough to provide a usable pattern.

It should be pointed out that any received modulation pattern is subject to errors due to both receiver selectivity and selective fading. In both cases significant sidebands may be cut off or drastically reduced. For the most accurate pattern only broad selectivity (10 kHz or more) and a non-fading signal will do. In spite of this, severe modulation faults can be detected with restricted bandwidth and the effects of selective fading can be averaged out.

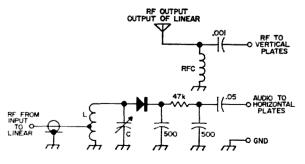


Fig. 4. This trapezoid circuit is very useful for checking the linearity of linear sideband amplifiers.

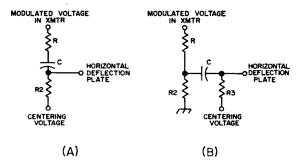


Fig. 5. Both of these circuits have been used for getting audio signals into the oscilloscope, but the circuit in B will introduce phase-shift.

Now let's consider the trapezoid type of display and the difficulties in obtaining it. The circuit of Fig. 3 has had some popularity in providing an "rf trapezoid" without any direct connections to the transmitter. Actually, all you can say for this circuit is that it *does* provide a trapezoid pattern. However, since the audio is derived from the signal itself, the af/rf ratio must always be linear, and it will not show when the modulation is non-linear due to underexcitation or over-coupling. Also, since the audio voltage on the rf output cannot exceed the rf voltage, this circuit will not show how much the carrier is being overmodulated. In effect, then, this circuit can only tell you if you are putting out rf and if your modulation is less than 100%.

The rf trapezoid circuit shown in Fig. 4 is very valuable in checking the linearity of linear amplifiers. It compares the audio modulation of the linear's input with its output, and any non-linearity shows up as a curvature in the leading edges of the trapezoid. This circuit, like that of Fig. 3, will not show any modulation faults except under-modulation.

The real trapezoid pattern compares the modulating audio with the audio envelope of the rf output. If the two are in phase and the modulation is linear, the sloping edges of the pattern will be straight. Nega-

Fig. 6. If you experience problems with the circuits shown in Fig. 5, try the circuit in A. The circuit of B is useful when it is possible to make a direct connection to the horizontal deflection plate.

tive overmodulation is clearly indicated in degree by the length of the horizontal line beyond the tip of the triangle formed at the 100% point. The difficulty in obtaining a trapezoid, or bow-tie, pattern with most oscilloscopes lies in getting the audio voltage to the horizontal deflection plates exactly as it modulates. To do this you must determine exactly where the modulating signal is applied to the circuit (plate, screen, grid, or cathode) and wire into that point. Use a series blocking capacitor of .01 mF. We must avoid any phase-shift between this tap point and the deflection plates. Very few oscilloscopes provide a direct connection to the horizontal deflection plates, and only the most expensive ones have direct-coupled shift-free horizontal amplifiers. To avoid phase-shift, which turns the leading edges of the pattern into ovals, we must avoid resistance-capacity coupling. The circuit in Fig. 5A must be used for coupling audio voltages to the deflection plates, but the R2-C-R3 combination of Fig. 5B (common in R-C amplifiers) will cause phase shift.

Try using the connection shown in Fig. 6A for the horizontal input along with the vertical input circuit used for the envelope pattern. The series resistor should be non-inductive and high enough in resistance so the audio will not overload the oscilloscope input. Normally a value of ten to twenty megohms is used for plate modulation. If you still get phase shift you will have to remodel your scope or be content with the pattern obtained. If you can make a direct connection to the horizontal deflection plates, try the circuit of Fig. 6B.

In all these diagrams the output is fed to a single deflection plate. It is assumed that this deflection plate is isolated from the power supply with at least a ½ megohm resistor while the other plate is by-passed to ground

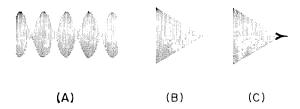


Fig. 7. Typical patterns obtained with a monitoring oscilloscope. In A the envelope pattern is modulated nearly 100%—at the 100% point, the pattern will go to zero at the nulls. The trapezoid in B is exactly 100% modulated while the trapezoid in C indicates an overmodulated condition.

with an adequate capacitor. While push-pull operation is the best for scope deflection, it is impossible to obtain in most monitoring circuits and single-ended feed is perfectly adequate. Any oscilloscope that provides direct connections to the vertical plates can be used as a transmitter monitor, and any instrument with a wide-band vertical amplifier can monitor received signals. The same scope might be used for both purposes if a relay is used to switch the vertical plates from direct to internal amplifier when going from transmit to receive. However, the trapezoid pattern can only be obtained when using specialized oscilloscopes, or by making special adaptions to regular instruments.

When viewing the envelope pattern the best horizontal sweep speed is either 60 or

30 Hz. Either of these frequencies will stop any 60 or 120 Hz hum, making it easy to identify. A sweep rate of 15 Hz or so makes it possible to see the keying characteristics of a CW transmitter, especially if a bug or electronic keyer is used and it is synchronized with the sweep frequency.

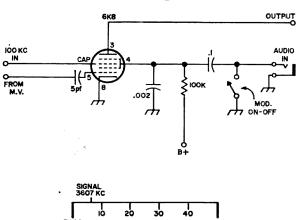
Many scopes provide internal synchronization and this may be used to advantage when the scope is used with a receiver to stop the audio wave forms. If you own an oscilloscope and are *not* using it as a monitor you are missing out. Use your scope and *know* what your modulation characteristics are; when receiving, pride yourself on accurate hum and modulation percentage reports.

. . . WØOPA

A Frequency Measuring Refinement

For measuring frequencies many of us still use the somewhat antiquated but still accurate procedure entailing a 100 kHz standard and 10 kHz multivibrator with associated variable audio oscillator. The secret then, if there still is one, is that a signal falling between a pair of 10 kHz markers will generate a beatnote of not more than 5000 Hz with the closest marker.

Thus, for example, from the receiver dial it can be determined which marker the signal is closest to. The resulting beat note, when matched with the audio oscillator, comes out to 3000 Hz. Then 3610-3 equals 3607 kHz. Some frequency measurers perform this feat with an earphone attached to the audio oscillator on one ear and a receiver earphone on the other. Others feed the audio signals into an oscilloscope and watch for the circular pattern which indi-



cates zerobeat. But there is a simpler way—simpler yet yielding an important additional advantage. Rather than diddle with neon bulb oscillators and the like to modulate the standard markers for easy and positive identification, why not use the audio oscillator? Each crystal marker will then have a distinctive musical tone, the pitch of which can be varied to suit the operator's taste. Then when the rf signal to be measured is located on the dial and the nearest standard marker identified, the audio oscillator dial is varied until the audio note matches the heterodyne and Voila!—there's the answer, quickly and painlessly.

My somewhat outmoded frequency standard employs a 6K8 mixer tube, but with obvious modifications this scheme would work as well on a variety of models of all ages. The only components I had to add to the original circuit for screen grid modulation were a .1 µF coupling capacitor, a modulation off-on switch and a phone jack to plug the audio into. The output attenuator on the audio oscillator is adjusted to give the best heterodyne with rf signals of different strengths. An alternative method which will work with any tube is cathode modulation. Just insert the low impedance secondary of a plate to voice coil transformer in series with the cathode of the tube to be modulated and impress the audio across the primary.

. . . Robert Kuehn WØHKF

A Basic Desk

Having lived in thirteen different houses and apartments in four states and two DX countries in the short time I have been a ham, I have probably encountered the problem of setting-up-a-shack more often than many of my more stable friends.

At each move I have faced three major problems: Antennas. . Where to locate the shack. . What to use for a desk or table at the operating position.

Antennas are the subject of another article. Location of the shack depends on the architecture of the house, and in my case, has been in such places as a hall closet, the toilet, the garage, and even, in one instance, a spare bed room. (Imaginel A whole room to myself!—Shared only with two years supply of staple foods, ski equipment and winter clothes in the summer, and bicycles and summer clothes in the winter.)

Each time, a desk for the operating position was a new problem to be met and solved. A folding card table (usually available and used) is too flimsey. A large desk is too heavy to move between cities and countries and often space is not available (I wonder how a big roll-top desk would have looked in that hall closet). After ten

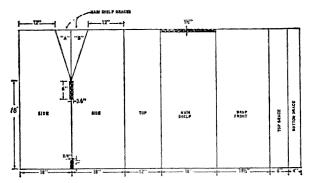


Fig. 1. Pattern layout for the basic desk operating cabinet. It's laid out on a 4' x 8' sheet of 3/4" plywood.

years a decision was made-"Something Must Be Done."

What are the desirable characteristics of a ham desk? Strong enough to hold the gear, but light enough to move (if only to clean behind it). Small enough to adapt to available space, but large enough to hold the receiver, transmitter, and associated gear. Inexpensive enough to gain, yet attractive enough to hold the XYLs approval.

A glimpse of a small, old fashioned, dropfront secretary started me on the general design and some doodling on paper finalized it.

The result is a functional desk, occupying only six square feet of floor space, but offering nearly nine cubic feet of space for operating equipment and 15 cubic feet of space for storage.

A single sheet of %" plywood provides the complete basic framework. Eight feet of 1x8 and six feet of 1x4 white fir, a 20" x 44" piece of %" plywood, a 36" piano hinge, four cabinet hinges, two drop-stops, and assorted nails, screws, and glue complete the bill of materials.

Construction

The cabinet maker-carpenter should skip the following step-by-step which is offered as a result of my hindsight—It would have been much simpler if I had done it this way!

- 1. Layout the pattern (Fig. 1) on the plywood sheet. Plywood is normally clear on one side but has knotholes on the other. Juggle the pattern so the drop-front and the upper halves of the sides are clear wood on both sides.
- 2. After cutting the plywood (Caution: Keep your cuts square) smooth all cut edges with a plane or sand block.

- 3. Fasten the main and bottom shelf supports (A & B Fig. 1 for the main shelf and two 18" pieces of the 1x4 for the bottom shelf) to the sides with at least four 1½" wood screws in each. (These pieces must hold the entire weight of all equipment installed.)
- 4. Assemble the top and bottom front braces and the door divider (the door divider is made from the rest of the 1x4) and fasten the assembly to the front of the desk sides in the cut-outs. (Add a temporary brace across the back and keep all corners square.)
- 5. Attach the main shelf, the top, and the bottom shelf, in that order. (The front edge of the main shelf should be flush with the slanted edges of the sides and joined carefully to the top front brace—this area will be exposed when the drop-front is closed and care in fitting now may save a pound of wood filler later.)
- Keep the corners squarel
 6. Attach one side of the 36" piano hinge to the inside bottom edge of the drop-front and hold the piece in position against the front of the desk frame. Carefully mark the spots for the screws—insure the drop-front will open and close—and then fasten the other side of the piano hinge to the front edge of the main shelf. The top edge of the drop-front will overlap the top. Sand and plane the top and the top edge of the

drop-front to a flush fit when the front

7. Fasten the drop-stops to the inside of the drop-front (the exact position will depend on the type of stop) and, with the drop-front horizontal, mark the positions for the screws on the desk sides. AFTER you are sure the drop-front will open and close without binding, fasten the drop-stops in place. (Be careful here, some of these gadgets have a real tricky action.)

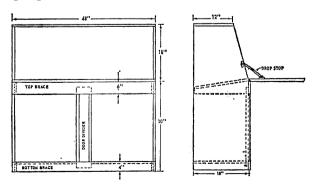


Fig. 2. Front and side views of the desk.

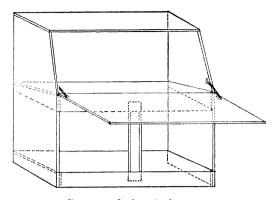


Fig. 3. Overall view of the desk.

8. Cut the **" plywood to fit the door openings and fasten with the cabinet hinges. This completes the basic assembly.

Pigeon-holes, outlet strips, master switch, etc., and the finish—paint, stain, or self-adhesive plastic in color or woodgrain—will depend on the individual builder and the equipment to be installed.

At my shack, I have (when it's cleaned up) my clock and globe on the top; SWR bridge, antenna switch, and a multiple ac outlet fastened under the top; xmitter, power supply and receiver sit on the main shelf; my key is fastened to the inside of the drop-front; and I am storing a kW power supply (not in use) and an over-sized MOPA (awaiting a novice-in-need) on the bottom shelf—all with pleaty of room left over.

I intend to install pigeon holes under the top and add a master switch that cuts all ac when the drop-front is closed.

Consideration has been given to adding a detachable leg (to be stored behind the desk) between the drop-front and the floor to brace the desk while trouble-shooting heavy equipment on the drop-front, but, so far, this has not been necessary.

The final result is a compact, attractive operating center that I need not apologize for when showing my shack to a stranger.

The total cost—under \$15.00

Postscript

Since designing and building my "basic" desk, I have retired from the Army, bought a home with an extra room for the shack, and settled down in Ogden. Anybody got a good blueprint for an impressive, unitized, builtin, corner console?

. . . wøqoj

is closed.

Is Rock-Bounce Practical?

We have all heard of the magnificant results which have been achieved on VHF, both 2 meters and 70 cm with Moonbounce; is it possible to get results by Rock-Bounce? We all know the effect of ghosting on TV receivers which can be brought about either by a mismatch in the feed line resulting in delayed signals reflected back on the feeder or by reflection off other objects.

This effect can also be observed on the VHF FM broadcast transmissions when a signal is reflected by a distant object and arrives at the receiving antenna after a delay. This ghosting on VHF FM broadcast is not as easily observed as TV ghosting, as there is no "visible" shift in the signal, but bad quality reproduction results from two or more out of phase signals being received.

I had a very good example of this effect when I was installing a VHF FM receiver for hi-fi broadcast reception at my Dorset QTH. I am virtually line of sight to the VHF FM transmitter across the sea, and I erected a dipole to receive the signal. Stupidly, and without adequate thought, I connected the dipole to the receiver with a coaxial cable. The quality of reception was bad; I could not understand why.

I was also interested to get reception of the VHF FM Broadcast signal free from interference from my own amateur transmitter. Here too I was in trouble.

To clear the interference from my own transmissions I substituted shielded twin balanced feeder for the coaxial lead on the broadcast receiver fed through a balun. This not only cured the interference from my transmitter but also brought about a startling improvement in the quality of the broadcast signal.

It appeared that the broadcast VHF FM signal was being received over two paths; one the direct signal, and the other by reflection from Portland Bill, a large rocky promontory jutting out into the sea at right

angles to the direction of the broadcast station. Little of the reflected signal would have been picked up by the dipole, as Portland Bill was off the end of the wire, but apparently the outer conductor of the coaxial feeder was picking up the reflected signal off Portland Bill and mixing it with the direct signal. The use of shielded twin balanced feeder completely cured the distortion.

Can similar effects be found on the high frequencies? This was a question which has often intrigued me. It is, of course, far more difficult to establish whether a signal rereceived is the result of a "bounce" or not, since at high frequencies it is possible for the signal to be received by normal propagation, reflection from the ionosphere, sporadic E, etc. It will, therefore, take longer to reach definite conclusions. Meanwhile the development of mobile operation enables certain experiments to be initiated.

Much experimentation has, of course, been going on by mobile operators with regard to good and bad locations for mobile operation. Some operators have been experimenting on VHF, others on the HF Bands while others have experimented on the LF Bands—G6GR has done much work on 160 meters and comes to the conclusion that low lying locations give him better results than the tops of hills. He attributes this to getting nearer the water table.

My own experience on the HF Bands, 14 and 21 MHz tends to favour the hills. It is not the actual height above sea level which matters but whether there is a clear shot in the direction one wishes to send the signal. One or two experiences, however, seem to indicate that a hill behind the transmitter could be an advantage.

For example, at my Dorset QTH, the sea shore runs NW—SE and one would therefore expect good results to the SW and, in fact, everywhere from S through SW to W. This is confirmed in practice. However, a hill runs parallel to the coast line about 500 feet high and about half a mile back from the coast. From here a magnificent view is obtained to the S, SW and W, and one might imagine that with 500 feet of height even better results would be obtained. This has not proved to be the case. Results at sea level, or 30 ft above sea level at the coast have consistently been as good as those from 500 feet up with an even better shot. This could be due to the proximity of the salt water and the salt impregnated land-which is G6GP's theoryor it could be due to reflection from the hill behind. As yet I have no means of proving which is correct-it may be due partly to each effect.

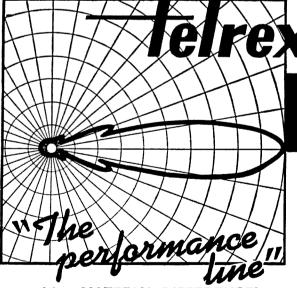
This year I obtained licenses to operate in several countries in Europe (Holland, Belgium, Luxembourg and Austria) and was able to carry out experiments in varying country. Austria is a very mountainous country and it was, therefore, very interesting to be able to experiment in various mountainous locations. On one occasion we were at Obermoos, just above Ehrwald at the foot of the cable car railway which goes up to the top of Zugspitze. Here we were parked on a small plateau at about 4000 feet above sea level almost completely surrounded by mountains. Only towards the NW were the mountains a little less high. I faced the car towards the NW (the polar diagram of the car is not completely omni-directional—there is a definite lobe towards the front of the car) and switched on the rig. We were running a Drake TR3 to a Mark Mobile HW3 Tribander. A few east coast W's were coming in and I worked a few W1's and W2's.

Then I was called by a W6! This surprised me. I worked him and he gave me 4/2 report and was just as surprised to hear me. When I signed I was called by a W5; then I went on working W1's and W2's. How was it that I suddenly worked out to the W6 and W5? As I was closing down to drive home I looked at the car and the location and I noticed that immediately behind me, exactly opposite to the direction in which I was firing was the huge, almost vertical, 5000 foot rock face of the Zugspitze. Were the W6 and W5 QSOs due to rock-bounce?

The next day I again chose a site with a good 'shot' to the NW with a rock face behind me. This time it was a smaller rock face but much nearer the car. We went straight through to Detroit!

It is, of course, far too early to draw any conclusion from the crude initial trials, but it does look as if rock-bounce is possible, and I hope this article will stimulate others to carry out further experiments along these lines. Mobile operation presents an excellent opportunity for such tests on an amateur basis.

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Moonray

Amateur operation from the moon.

When will we hear the first amateur radio station from the moon? It may be sooner than you think. With plans presently being formulated by the Nassau Satellite Tracking Amateur Radio Society, NASTAR, the first lunar rig could be on the air minutes after the Apollo astronauts make their third successful landing in the Lunar Excursion Module (LEM for short).

NASTAR, a group of amateurs at Nassau Community College on Long Island, bases its thinking-and hopes-on several important facts. First of all, the unofficial word from NASA and other sources indicates that there could be space for an amateur transponder on the third LEM trip to the moon. The possibility is further enhanced by the fact that NASA has agreed to study a NASTAR proposal for a Moon Amateur Relay-Moonraywhich will be submitted to them later this summer. The proposed unit will serve as a long-term site beacon and, if needed, act as an emergency communications package for the astronauts. The present plans call for the first Moonray prototype in 1969 and the NASTAR group has already secured commitments for environmental testing help from NASA, Grumman and RCA.

For those of you not familiar with environmental testing, every part that goes on a space shot requires a rigorous program of test before it is "qualified". Qualification includes—besides normal functional testing—a complete series of environmental tests that include altitude, humidity, vibration, shock, heat, vacuum, and salt-spray. Successful completion of these tests fairly well insures that the part will successfully make it through launch, separation and the long flight through space. Why salt-spray you ask? Since the majority of our launch sites

are located near the ocean, the parts on board are often exposed to the elements while waiting for the launch date.

NASTAR is an independent, three-yearold ham group which was given its own building and a mile of space for an antenna farm by Nassau Community College. Last year the group gave a ten-week course in satellite tracking, which was the first ever offered at a Long Island college and possibility the first of its kind in the country.

When NASTAR was organized three years ago, its first home was unique. Nassau Community College took over part of Mitchell Air Force Base as its campus and NASTAR's first shack was in the old glass-enclosed control tower. Last year the college gave the group its own building, a former field house. The building also provides quarters for NASTAR's astronomy section, formerly the Sperry Astronomy Club, a library alcove, and a workshop.

NASTAR headquarters houses kilowatt rigs for the high-frequency bands and two meters as well as other transmitters on 6 and 432, plus associated receivers, converters and recording equipment. In addition, the group recently acquired a completely operational SCR-584 radar unit for satellite tracking in a 24-foot trailer which will soon be towed to a location right outside the shack.

This past fall an anonymous angel installed five eighty-foot poles outside the building. Already on them are a 40-meter wire beam aimed at OSCAR headquarters in California and 4UIITU in Switzerland for relay work; a wide-spaced 20 meter beam; a six-meter Squalo stack and two-meter Big Wheel for announcements and

bulletins; a three-band beam to track OSCAR V's ten-meter transmissions; 44 cross-polarized elements plus two 11-element two-meter Yagi arrays for OSCAR tracking and an assortment of long V antennas. A forty-foot steel tower that formerly held an Air Force siren is waiting erection to hold 432 and 1296 MHz arrays.

Actually, the group does not plan to "go it alone" on the Moonray project. Nick Marshall, W6OLO/2, NASTAR president and former technical director for the OSCAR program, says, "We hope to involve amateurs all over the world in this project. There are many other organizations such as ours, as well as *individual* amateurs, who can contribute vital thinking and technical assistance."

The Moonray concept was originated by NASTAR's president. A ham for 31 years, Nick is an electronics consultant for NASA, the Lamont Geophysical Observatory and various electronics firms. He says, "We have the know-how to build a relatively sophisticated package like Moonray. We've proved that by the success of the OSCAR program. What we are hoping is that Moonray will be a truly collective ham effort, based on advice and help from hams everywhere. We'd like to be able to say that Moonray is a product in which the whole ham fraternity had a hand."

Leonard Victor, W2DHN, NASTAR executive vice president, added, "Right now we're worrying about keeping our bands. This project is the type we need to prove that amateur radio still has something to contribute to the state of the art." He also points out that, "A couple of transponders capable of allowing contacts between any two points on the half of the earth facing the moon at the time might even make a dent in the load on twenty!" One thing Moonray will do, he promises, is shorten QSO's because of the time lag caused by the signal's round trip to the moon and back.

Nick hopes for a flood of responses to help in solving some of the serious questions which must be answered before the preliminary proposal is submitted to NASA later this summer. For example, what bands should be used for reception and re-transmission from the lunar surface? NASTAR currently favors the use of 432 MHz, but they are anxious to hear from other amateurs who have another band in mind or would like to see multi-band operation. In addition, pow-

er output, bandwidth, the antenna system, and the type and extent of the beacon telemetry system must be decided.

Three parameters of the Moonray package are already fixed. In addition to its transponder capabilities, it must be operable as an independent backup emergency voice communications package for the astronauts in the event that they experience trouble with their regular radio gear. Furthermore, Moonray must serve as a low-power beacon to be used for locating the LEM landing site one or two years after the astronauts have returned to earth. These potential services as communications backup equipment for the astronauts and site marker beacon are the reasons NASA is willing to consider Moonray's inclusion on the flight.

The third fixed Moonray parameter is that it will be nuclear powered. This is to permit its use through the lunar night, when solar cells would be inoperative. NASTAR has an almost solid promise of a five-pound, ten-watt nuclear battery with a 25-year half-life. In addition to powering the Moonray receiver, transmitter and marker beacon, this battery will be used to heat the package during the -275 degree lunar nights.

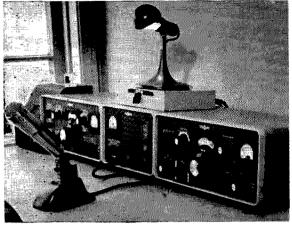
Membership in NASTAR is open to all licensed amateurs who are seriously interested in—and willing to work at—some phase of the group's work. This ranges from equipment and antenna construction to operating VHF and UHF equipment and recording gear. If you are interested in helping out on this program, why not write to them?

If nothing else, you may be able to offer suggestions for the pending Moonray proposal. If you're within two-meter range of Long Island, their members meet weekly on Monday nights at 2000 EST on 145.85 MHz. Better yet, check in on their regular Sunday morning work sessions.

If Moonray is to be on the third lunar landing sometime in 1970, it's going to take a lot of work and planning now on the part of the entire amateur fraternity. OSCAR was our first step into space, Moonray could well be our second. Amateur operation from Mars, Venus, and even Jupiter may be possibilities in the future. However, one step at a time. If we all pull behind NASTAR now it will be a step in the right direction.

. . . W1DTY

^{*}NASTAR, Post Office Box T, Syossett, Long Island, New York 11791.



The switching box on top of the SWR bridge.

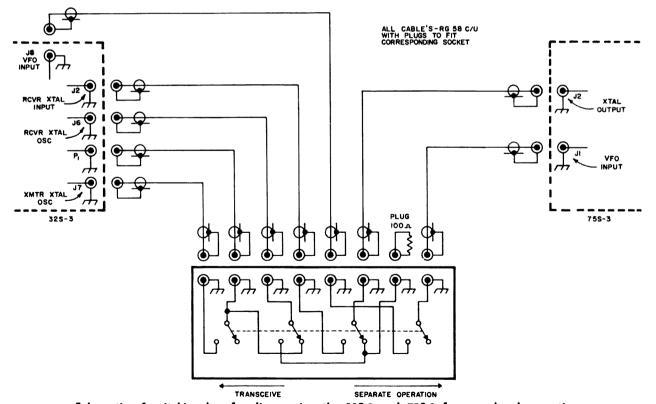
A Simple Switch to Separate the 32S-3 and 75S-3 for Cross-Band Operation

The Collins 32 S-3 exciter and the Collins 75 S-3 receivers are designed to be operated either in transceiver operation or each unit may be operated separately. If the units are to be used in transceiver operation, connecting plugs and cables are used to connect the exciter and the receiver together. The 100 ohm dummy load plug is removed from the receiver and inserted in the exciter. When the units are connected together in this way, it is possible to operate them separately but only within the same 200 kHz band segments. If it is desired, however, to operate

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the receiver and exciter cross band at more than 200 kHz frequency differential, then it is necessary to completely disengage the two units. This means that mechanically it requires the operator to unplug the connecting cables and reinstall the dummy load in the receiver.

To overcome this mechanical inconvenience of changing cables and making the other changes needed to switch from transceive to separate transmit and receive function, the writer constructed a very simple switching unit which remains in the circuit



Schematic of switching box for disengaging the 32S-3 and 75S-3 for cross-band operation.

at all times. By a simple flip of a single switch either function is instantly available without connecting or disabling any cables, or making any other changes.

The whole unit consists simply of a single four pole double throw switch such as a Centralab PA 1010, and eight tip jacks, a suitable box and seven connecting cables.

The wiring of the switch and connection of the cables is also shown on the attached diagram.

The reason that all this is necessary is

that with the patch cables connected for transceiver operation the receiver hf crystal oscillator controls the injection frequency to the transmitter second mixer. In order then to restore the units to independent operation from each other, the 100 ohm dummy load plug which was inserted in the 32 S-3 Xmtr Osc. jack J7 for transceive operation, is again restored through the switch to its original place in the 75 S-3 circuit, and the cables are electrically disengaged.

... W6EUV

Indian Traps

Here is one of the simplest TVI traps that a six meter ham can use. Sure it doesn't cost much to buy a low-pass filter that will take care of everything above 52 MHz, and a coaxial filter works even better as it will also reduce the "sub-harmonics" generated in the driver stages. But just where on the operating table are you going to mount one of those big coaxial tanks; and how much room do you have for it in a mobile set-up?

I had a simple home-made AM rig that I built primarily for mobile. Though it did put out a nice six meter signal, it caused a little cross-hatching on channel 5. My tv set doesn't have a high pass filter, but I doubted that it needed one, since my higher-power six meter sideband rig didn't cause any TVI at all. What I neded was something quick and easy to cut down the 75 MHz energy that was being generated in the 25 MHz doubler and was being fed through the final. Since late Saturady night is no time to go to the radio store to buy filters or parts, I needed something that could be built from accessible parts.

Remember your transmission line theory? A half-wave open line looks like an open circuit and a quarter-wave open line looks like a short circuit. Also, a three-quarter wave open line looks like a short circuit. I carefully measured off 77% inches of RG 59/U coax and put a PL259 connector on one end. This is 1/2 wave at 50 MHz, looking open; and % wave at 25 MHz, % wave at 75 MHz, 5/4 wave at 125 MHz, all appearing as short circuits. I removed the antenna lead from the transmitter, put on a coax "T", then put the antenna lead on one branch and my coax trap on the other branch of the "T". A few checks showed that this removed all traces on the TVI!

I cut the coax for a center frequency of

50.2 MHz and later checked it on some lab gear: attenuation of the desired 50 MHz signal was under % db. Attenuation at 25 MHz was 27 db.; at 75 MHz it was 26% db.; at 125 MHz it was 21 db. I can cover the lower megacycle of the six meter band with not over % db. insertion loss and still get at least 25 db attenuation on 25 and 75 MHz. Thus for the price of a few minutes time, a few inches of coax, one PL259 connector, and one coax "T" connector, I had obtained over 25 db. attenuation of my channel 5 harmonic. Naturally, there is no problem finding space for the small length of coax. It can be tucked out of sight behind the transmitter.

If you find you have 100 MHz energy leaking out, it would be a simple matter to add a quarter-wave shorted stub in the same manner. This would have no observable effect on the desired 50 MHz signal, but would do a fine job of knocking down 100 MHz energy. (Also 200 MHz, etc.)

This is not a cure-all, and it won't help a bit if your rig is radiating the interfering signal directly or feeding it through the power lines. Since I had checked that there was no interference at all when my transmitter was feeding a dummy load, I knew that I only needed a filter or trap at the antenna lead.

This coax trap is about the simplest method of reducing harmonics. It takes up little space, and is about as cheap as you can get. It would be very easy to coil up the coax inside the transmitter and connect it directly to the antenna terminal to eliminate the coax "T" and the PL259 connector. Incidentally, it also cleared up TVI on channels 4 and 5 when used with my Gonset Communicator.

. . . Jospeh Sheffer W9KLR

Construction Project: A High School Amateur Radio Club

Are you alone in your hobby of amateur radio? Would you like to interest other high school age guys (and gals) to the fun of hamming? After all isn't any hobby more fun if you have someone to share it with? As you can probably see by now, I am trying to talk to the high school age set. You OT's can go on to the other articles, but you teenagers stick with me. I will try to show you how easy it is to start this club. Every high school should have an amateur radio organization.

Maybe you are asking yourself right now, "Why a radio club in a high school?" I know for certain that many prospective hams are scared out of trying for a license by the expense. The high school club would overcome this by having a station for its members. Also, what better way is there to find out whether a person really likes electronics and radio than by trying it out? Enough of that. Let's find out how to start this club.

A club always needs a sponsor to see that things are run right. Science or math teachers usually are the easiest to get. The person picked should be well-liked and respected by the members. If he is already a ham, you're very lucky. If he is not, then try to interest him in becoming one. The club will run much smoother if the sponsor is familiar with hamming.

To start a club you need to have hams. The best way to get hams is to teach them yourself. Start a code class. Code is the hardest part in getting a novice ticket, but it is usually made much harder than it has to be. When being taught in a group by a

competent instructor, it is much easier. To be any good, the class should meet every day. A good time is about a half an hour before school starts when everybody is fresh. The code source can be a code oscillator although code records or tapes are less work. At any rate make sure this class is held regularly, well instructed, and NOT BOR-ING!

A meeting place for the club and a room for the club station is also needed. Even a corner of a room is suitable for the station. It often works out that the room is the sponsor's classroom. Just be sure that it will be a safe and convenient place for the equipment.

Getting a club station is sometimes the largest obstacle. But it is also one of the most important aspects in that it is sometimes the only place the younger members have to operate. The first year the club is in operation, the school probably will not put up any money for a station. If the club goes well, the second year they will probably set aside some for that purpose. But that still leaves the first year open. This is where your state MARS program can help. Contact your state MARS coordinator. With his help try to get some surplus ARC-5 equipment. In many states the MARS youth program will give ANY new novice free ARC-5 equipment. Also look into getting a MARS affiliated club station. If (and when) the club does get some money, get the best receiver you can afford. The club members can always build some transmitters or you can use surplus. Where there's a will, there's a way.

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The club station will need a license. This is no problem. All that is needed is a general class operator to sign a Form 610 as trustee of the club. Of course, it would be better if the trustee were a member, but any local ham will do.

After the club is going well, and you have graduated your first code class into novices, keep the club going by making your meetings interesting and fun. Remember, we younger hams like action so give us plenty of it. Hold numerous contests. Show films at meetings. Hold fund raising activities. Get some good speakers. Have initiations for new members. Operate Field Day and in nationwide contests. But keep things moving. Do not let the club bog down or it will fold. This is good advice for any club.

This makes six steps to starting a good high school amateur radio club. They are as follows:

- 1. Get a good sponsor (preferably a teacher).
 - 2. Start a code class.
- 3. Find a meeting place and a room for the club station.
 - 4. Try to get a club station.
 - 5. Get a license for the station.
 - 6. Keep the club interesting.

Conquer each one of these steps separately and well, and you will have a firm foundation for a good club.

Alright you teenage hams. I have done what I can. The rest is up to you. Watsa we double the number of high school radio clubs in the next year. Let me know how many of you do start a club. I do not know whether I have struck oil with you or not, but I am going to quit boring.

. . . WAØNDV

New Medical Service via Ham Radio

A new and much needed medical service began last fall when Duke University Medical Center Amateur Radio Club began PROJECT MED-AID (Medical Assistance for Isolated Doctors) to provide up-to-date medical advice, consultation and encouragement to doctors working in remote areas throughout the world.

To provide this service the Club station, WA4BLK, is manned daily, and the frequency of 14,250 kHz is monitored continuously. Doctors on duty from 0900



Dr. E. Croft Long, Director, Project Med-Aid, Professor of Community Health Sciences and Lee Williamson one of the operators.

through 1700 EST can pick up the nearest telephone and confer with distant MDs whenever they call in, and, when MDs are busy or off duty, the inquiries are taken down on a tape recorder and the replies similarly recorded as soon as possible and transmitted back to the overseas station.

The project was sponsored by the Mary Reynolds Babcock Foundation, of Winston-Salem. Although funds cannot be provided for stations at distant points, lists of equipment are available to help other interested groups do this. Those interested in supporting this work may obtain copies of these lists (describing complete field installations from 200 to 1000 watts) by writing to the Director, Project MED-AID, Box 3005, Duke Hospital, Durham, North Carolina, 27706. Telephone 919-684-8111, Extension 2498.

Amateurs working near the frequency of 14,250 kHz are urged to check carefully to see that they are not interfering with this vital work. By the end of the year it is expected that from 40 to 50 isolated medical and hospital outposts will be set up to participate, so there should be increasing business on this frequency, and this should be another means of demonstrating to some of the newer countries how very useful to them amateur radio can be.

Heath HR-10 Modifications

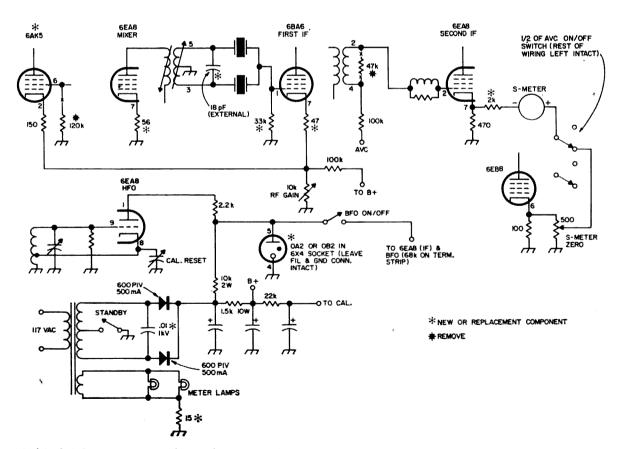
The Heath HR-10 receiver is an excellent choice for the novice, but with our crowded bands these days, improving the selectivity of any receiver is a worthwhile project. The modifications described here include increased selectivity and sensitivity and make the set act as if it cost much more than the total outlay for the circuit changes—a mere twelve dollars.

Since the HR-10 appears to be a very popular receiver with novices and generals alike, these modifications will be for the mutual benefit of all. In addition to the sensitivity and selectivity improvements, I added

voltage regulation, rearranged the rf gain control, put in a new S-meter circuit, and added a solid-state rectifier.

In the front-end I replaced the 6BZ6 rf amplifier with a 6AK5. Before installing the 6AK5, remove the 120k screen-grid resistor from the circuit and lift pin 7 of the tube socket from ground. The increased sensitivity is well worth this simple modification.

To improve the stability for SSB and CW operation, I added a voltage-regulator tube. I used an OA2 because I happened to have it in the junk box, but an OB2 should work just as well. Since the 6X4 rectifier is re-



Modified HR-10 circuitry. These changes result in improved sensitivity, selectivity and stability.

placed by two 500 mA, 600 PIV silicon diodes, the 6X4 socket is used for the VR tube. In addition, you will need some additional solder lugs. This can be accomplished by installing a 3-lug terminal strip in place of the 2-lug strip which is mounted near the 6EA8 in the mixer section.

In this modification most of the harness cable can be rewired and rerouted to the new point, saving wire and preserving overall neatness. To install the new S-meter (Lafayette 99R2514), remove the pilot light in the left-hand corner, remove the old S-meter and the black metal bracket and cut a 2%" hole through the front panel. Cut the hole so the old S-meter calibration points are removed in the waste plastic.

Alignment

The HR-10 in its modified form is a very sensitive receiver, and since we are squeezing the last bit of performance out of it, the alignment of the various stages is a little painstaking. The first step is the alignment of the *if* stages. If you have a signal generator, all well and good. If not, use a beat note from the crystal calibrator. For proper selectivity the *if* transformer slugs are set for the first peak after the slugs are screwed all the way out and back in again.

If you encounter oscillation in the *if* stages, it can be cured by lowering the value of the 6BA6 grid resistor, slightly detuning the second or third *if* or shunting the second *if* transformer with a 68k resistor. After you are satisfied that the *if* stages are properly aligned, proceed with the alignment of the rf stages.

Results

After these simple modifications, the set works like a charm. In fact, it is too selective for AM work, but just dandy for CW and SSB. In addition, frequency stability is excellent, and it takes a pretty large fluctuation in line voltage to make it jump off frequency.

Setting the rf gain control has no bearing on S-meter position—it just decreases sensitivity, lowering the reading, but not pinning it up scale. I find that on forty meters I seldom have the rf gain control much above the one o'clock position.

I would like to thank Ted, VE3ABN for typing, and John VE3FWX, for his constructive criticism.

... VE3FYL





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Glub, Glub, I'm Drowning

After an evening of listening to the hash on 80, the average amateur may or may not, dependent upon his age, recall bygone days when the noise level seemed lower. Maybe this falls in the category of remembering the snow storms which seemed heavier, or the air which was purer.

At any rate, all this was triggered off by a recent article in one of the Denver papers entitled more or less "Is Denver Drowning". In this instance, the reference was to the air which on occasion gets a bit thick, particularly on days when the wind forgets to blow. By coincidence, this article appeared during the same week that an interference committee had a scheduled meeting. Possibly with the question of air pollution in the back of his mind, the guest speaker raised the question in retrospect as to whether or not we, meaning those involved in communications in one way or another, are drowning in our noise.

Unfortunately, as the meeting developed, the problem is not a temporary one which can be forgotten with a chuckle. And as the meeting and discussion progressed, some of the bits and pieces which may come back to haunt us started to show up.

The type of noise discussed and mentioned here is "random noise". It is the type of noise that is generated anywhere a measurable amount of electric power is consumed. In particular but not exclusively, it is something every one of us citydwellers contributes to in one way or another. The "random" designation is to separate if from the deliberately generated noise such as that of the frug or the watusi on the local AM broadcast. Naturally since this noise is generated in fashion or another, we as individuals generally feel that this is the problem of: a. The Government b. The State c. The Power Company d. Somebody Else. But not necessarily in that order. Strangely enough, we may even break down and admit that we as individuals might be just a little bit responsible, but unfortunately,

we are not about to change our way of living just to knock down a bit of noise. Or are we? This "noise" thing is like the statements made by the friendly neighborhood bank about the compounding of interest on your deposit only this time, we do the paying.

So then how do we as individuals contribute to the random noise figure? Turn on a light, the switch arcs, presto-noise! Start the car, run a drill, a grinder, electric beaters, the lawnmower and on and on with each item feeding in a little more random noise. Not much on an individual basis but when you examine the amount of rotating equipment alone in the average metropolitan area, the not much suddenly becomes the very much.

The increase in the random noise level over the years can be related to the increase in kilowatt hour consumption, and of course the increase in automobiles and its ignition system, compounded even here by transistorized ignition systems with the higher voltages and on and on.

Stop! You got me there! Great strides have been made in decreasing ignition noise by shielding, by filtering, by grounding, and even by switching over to a Diesel engine. The efforts, the tricks, the articles all concerning taming a wild ignition system are many. The use of the carbon type resistance wire might be cited as one of the steps forward, or is it? I wish I could mention the name of the individual who ran some tests on this type of ignition wire but since I do not know how he would feel about it, I shall pass on that.

At any rate, this individual, according to my sources, made a series of checks on the carbon wire and found that after eight to twelve thousand miles, the effectiveness of the wire showed a definite decrease. Evidently something was happening after this amount of mileage that had a detrimental effect, however, no major change in the appearance took place, just a change

in the effectiveness. A bit of investigative analysis by some other interested parties turned up what would appear to be a super simple answer. The ignition system was originally installed on a new car, after the "trouble" stated mileage, the appeared. What if anything happened at this time out of the ordinary? Nothing except the routine change of plugs by the careful car owner. So here is wire of carbon composition, after months of exposure to the elements, it is suddenly clutched by a mechanic, jostled, tugged, bent, and so the trouble appears. Sounds like a plug for the do it yourself mechanic.

More on cars, not from the point of quieting one for use as the transporter of mobile equipment, but instead viewed as a culprit. Are any particular brands of horseless carriage more responsible for noise than others? Two makes that received particular mention were the popular VW and the Jaguar. Of these two, the discussion concerning the Jag was by far the most interesting. One individual who was a combination amateur, sports car fan, and employed in communications, made several remarks concerning of all things, the hood on the Jag. The hood is metal. It is apparently grounded via the hood hinges, or is it? He indicated that from experience, the Jag ignition system in operation, is a fine source of corona display. So effectively, we have a source of random rf under a metal (grounded) hood. However, since in the interest of antirattle, the hood is equipped with rubber bumpers, we find instead that the dimensions of the hood very handily couple energy from the "source" to the surrounding space. How Now Brown Cow? Back to the grounding straps, provided of course you own the car. If you don't, then suffer!

Well cars are found in the greatest volume around cities. So lets fool them! Move out to that hill on the outskirts and enjoy suburbia with a view of the city lights. Sound fine, but then again is it . . . Some measurements on random noise made by a private concern over and around a major west coast city (not Denver, thank heavens) indicated that the "noise signature" of the city could be read up to 40 miles away. The measurements were conducted primarily in the area of 15 kHz to 30 MHz. Care was taken not to measure as "noise", broadcast stations and other legitimately operating services. The pattern found did not

work out to be a smooth line soaring to the top of the graph, but instead, showed a definite scalloping tendency with peaks which might be attributed to harmonics of power line frequency in connection with rotating equipment. Working on the basis of an average curve from the measurements taken, it was noted that there appeared to be a decrease in the noise level of approximately 28 dB for each 10 MHz increase in frequency, up to approximately 30 MHz.

Keep in mind that this figure is in connection with the overall random noise picture and susceptibility of a particular frequency to say ignition noise is just a small

part of the overall noise picture.

The irony of the situation seems to be that the United States, as one of the world's leading producers and consumers of electrical and electronic equipment is feeding this sea of noise at an ever increasing rate while bemoaning the problems. In some cases, communications problems are solved by a power increase which increases power consumption which increases noise and so on. With the complex power distribution systems in use throughout the country, it is small wonder that noise generated in one area pops up miles away. It might be an everpener to find out how many men and how much equipment is maintained by the power utilities in the nation now as compared to ten years ago. Certainly cooperation by power company personnel is easier than ever to obtain when power line noise problems arise. Chalk it up to nice people, desire to maintain a noisefree system, or just public relations, the amateur is the one who benefits.

Bills to enlist government support have been introduced and died. Well, it took a while for the pressure to be put on TV set manufacturers to conform to minimum radiation standards. Maybe one of these days, when the noise builds up to a roar, the opportunity to pressure people in the position to obtain such legislation may present itself. In the meantime, the cheapie heating pads, "budget priced electric blankets" add to our woes. As a last grabber, the state of the art moves on and we find ourselves with hotter receivers which immediately latch on to the increased noise making it sound even better, which forthwith calls on the noise blankers, which consume more power, which. . .

. . . WAØNQL

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C. LeRoy Kerr, WA6CTK
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Virgin Islands Semicentennial Week



Photo by Winifred A. Scott

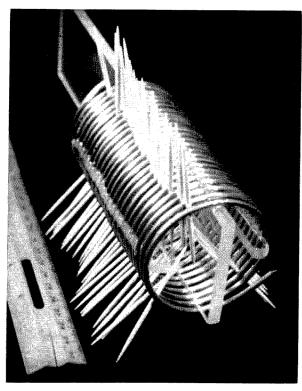
An amateur radio station established by the Virgin Islands' Semicentennial Commission and operated in conjunction with the islands' 50th anniversary observance will be donated to the St. Thomas branch of Boy Scouts of America and run as the official B.S.A. Amateur Radio Club. During Semicentennial Week the station attracted many residents and visitors and over 500 contacts were made with hams throughout the mainland and the world. In this photo, left to right, Antonio Benvenutti KV4BA, Pat Miller KV4CI and Les Scott KV4EY demonstrate the operation of the station.

RSGB Welcome to London Scheme

Overseas visitors to London who wish to meet British radio amateurs are invited to telephone any of the numbers on the following list, so that suitable arrangement for their reception may be made. It would be of assistance if a preliminary letter, giving the dates of their trip and details of any special interests or needs could be sent to the Publicity Officer, Radio Society of Great Britain, 95 Collinwood Gardens, Clayhall, Ilford, Essex, England. The RSGB regrets that they are unable to undertake any accommodation bookings, although they are able to advise visitors who have difficulty in finding hotel rooms. They strongly advise visitors not to come to London unless they have made definite accommodation arrangements.

Direct inquiries from visitors to RSGB Headquarters will be re-routed to one of these numbers: 550-0882, Colindale 1443, Colindale 4770. Laburnum 5733, Wordsworth 5723 or SM8-5866. Your cooperation would be appreciated.

Spacing Homemade Air Wound Coils



After trying several methods for spacing the turns in air wound coils, I have come up with this method. It is cheap, easy, and almost fool proof. First wind the coil "tight" with the turns touching. Push the pointed end of the toothpicks between the turns at approximately 120 degree intervals around the coil and the spring tension of the coil will hold the spacers in place while the glue or epoxy sets firm. Either round or flat toothpicks can be used, depending on the spacing desired. Nails, or other metal spacers will scratch the enamel and should only be used on bare or tinned wires. The toothpicks can be easily removed when the glue sets.

. . Chuck Miller DL5AF/K4SEL

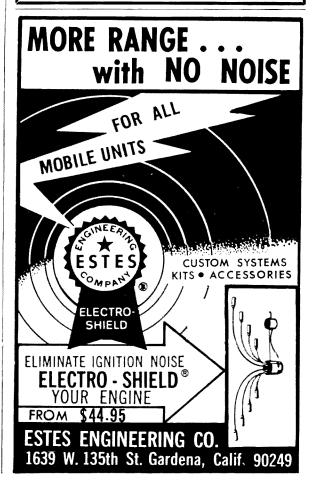
External SWR Bridge Meters

When using an SWR bridge with an external meter (such as for one man adjustments at the antenna), connect suitable rf chokes inside the bridge at the meter connections. Otherwise the meter leads may act as pick-up atennas and give erroneous meter readings.

. . . Richard Mollentine WAØKKC



PLEASE INCLUDE YOUR ZIP CODE WHEN YOU WRITE 73.



Technical Aid Group

The members of 73's Technical Aid Group are listed below. They are willing to help other hams with their technical problems. If you have a question about ham radio which can be answered adequately through the mail, write to one of the Volunteer TAG members whose specialty encompasses your query. Please write legibly and include a self-addressed stamped envelope with your request.

If you feel you are qualified to help other hams and would like to join the Technical Aid Group, write for complete details. To do the most good and to provide the best coverage, we need TAG members in all parts of the country. Right now all US call areas except W1 are represented as well as Europe

and South America.

Although 73 will help the Technical Aid Group with organizational help and publicity, we want it to be a ham-to-ham group helping anyone who needs help, whether they are 73 readers or not.

Bob Groh WA2CKY, BSEE, 123 Anthony Street, Rochester, New York 14619. Specializes in VHF/UHF solid-state power amplifiers, but will be glad to make comments on any subject.

Jim Ashe W2DXH, R.D. 1, Freeville, New

York. Test equipment, general.

G. H. Krauss WA2GFP, BSEE, MSEE, 70-15 175 Street, Flushing, New York 11365. Will answer any questions, dc to microwave, state-of-the-art in all areas of communications circuit design, analysis and use. Offers help in TV, AM, SSB, novice transmitter and receivers, VHF antennas and converters, receivers, semiconductors, test equipment, digital techniques and product data.

Don Nelson WB2EGZ, EE, 9 Greenridge Road, Ashland, New Jersey 08034. VHF antennas and converters, semiconductors, selection and application of vacuum tubes.

Stix Borok WB2PFY, high school student, 209-25 18 Avenue, Bayside, New York 11360.

Novice help.

Richard Tashner WB2TCC, high school student, 163-34 21 Road, Whitestone, New York 11357. General.

J. J. Marold WB2TZK, OI Division, USS Mansfield DD728, FPO San Francisco, California 96601. General,

Clyde Washburn K2SZC, 1170 Genesee Street, Building 3, Rochester, New York 14611. TV, AM, SSB, receivers, VHF converters, semiconductors, test, general, product data.

Theodore Cohen W9VZL/3, BS, MS, PhD, 261 Congressional Lane, Apartment 407, Rockville, Maryland 20852. Amateur TV, both conventional and slow-scan.

James Venable K4YZE, MS, LLB, LLM, 119 Yancey Drive, Marietta, Georgia. AM, SSB, novice gear, VHF, semiconductors, and test equipment.

J. Bradley K6HPR/4, BSEE, 3011 Fairmont Street, Falls Church, Virginia 22042.

General.

Wayne Malone W8JRC/4, BSEE, 3120 Alice Street, West Melbourne, Florida 32901. General.

Bruce Creighton WA5JVL, 8704 Belfast Street, New Orleans, Louisiana 70118. Nov-

ice help and general questions.

Louis Frenzel W5TOM, BAS, 4822 Woodmont, Houston, Texas 77045. Electronic keyers, digital electronics, IC's, commercial equipment and modifications, novice problems, filters and selectivity, audio.

George Daughters WB6AIG, BS, MS, 1613 Notre Dame Drive, Mountain View, California. Semiconductors, VHF converters, test

equipment, general.

Tom O'Hara W6ORG, 10253 East Nadine, Temple City, California 91780. ATV, VHF converters, semiconductors, general questions.

Steve Diamond WB6UOV, college student, Post Office Box 1684, Oakland, California 94604. Repeaters and problems regarding legality of control methods. Also TV, novice transmitters and receivers, VHF antennas and converters, receivers, semiconductors, and product data.

Orris Grefsheim WA6UYD, 1427 West Park, Lodi, California 95240. TV, HF antennas, SSB, VHF antennas and converters, receivers, semiconductors, and general ques-

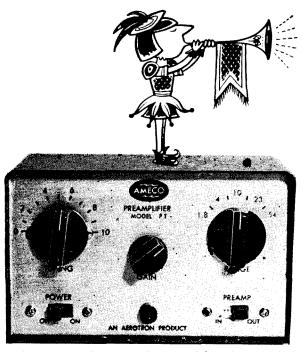
tions.

Hugh Wells W6WTU, BA, 1411 18th Street, Manhattan Beach, California 90266. AM, receivers, mobile, test equipment, surplus repeaters.

Howard Krawetz WA6WUI, BS, 654 Barnsley Way, Sunnyvale, California 94087.

HF antennas, AM, general.

Howard Pyle W7OE, 3434-74th Avenue, S.E., Mercer Island, Woshington 98040. Novice help.



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Charlie Marnin W8WEM, 3112 Latimer Road, RFD 1, Rock Creek, Ohio 44084. General technical questions.

Michael Wintzer DJ4GA/W8, MSEE, 718 Plum Street, Miamisburg, Ohio 45342. HF antennas, AM, SSB, novice gear, semiconductors.

Roger Taylor K9ALD, BSEE, 2811 West Williams, Champaign, Illinois 61820. Antennas, transistors, general.

Michael Burns Jr. K9KOI, 700 East Virginia Avenue, Peoria, Illinois 61603. AM, SSB, receivers, transmitters, digital techniques, novice help, general.

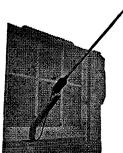
Robert Scott, 3147 East Road, Grand Junction, Colorado 81501. Basic electronics, measurements.

PFC Grady Sexton Jr. RA11461755, WA1GTT/DL4, Helmstedt Spt. Detachment, APO New York 09742. Help with current military gear, information from government Technical Manuals.

Eduardo Noguera M. HK1NL, EE, RE, Post Office Box Aereo 774, Barranquilla, Columbia, South America. Antennas, transmission lines, power and audio transformer design and construction, general amateur problems.

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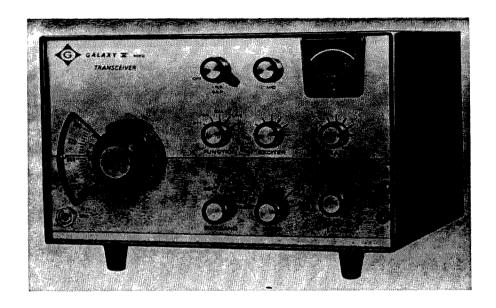
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The Galaxy V Mark 2

Jim Fisk WIDTY RFD 1, Box 138 Rindge, New Hampshire 03461

A quick glance at the new Galaxy V, Mark 2, five-band SSB transceiver leads you to wonder what changes were made from the previous model. The front panel certainly doesn't look very much different. The only changes evident here are the new vernier logging scale and removal of the "zeroing" knob. However, a look inside and a quick check of the schematic show that this new transceiver from Galaxy has actually been modified a great deal.

The most obvious difference is the large number of semiconductors that have taken the place of tubes. In the Mark 2, semiconductors are used in the VFO, high-frequency crystal oscillator, speech amplifiers, AVC rectifier and amplifier, CW sidetone generator, and receiver audio stages. In addition, the optional plug-in VOX accessory is completely transistorized.

The solid-state VFO is really exceptional—no less than four transistors are used: the oscillator, a two-transistor buffer stage and an output stage. The people at Galaxy are so proud of the stability of this new VFO

that they run a frequency-stability check on each transceiver and include the curve with the unit. The frequency drift on my Galaxy V, Mark 2, is less than 100 Hz in any fifteen minute period, and most of that takes place in the first thirty minutes after it's turned on. After forty-five minutes or so it's difficult to detect any drift at all. This was borne out when I had the opportunity to see the Mark 2 VFO run into a digital frequency counter—once you set it on frequency there were occasional 1 Hz drifts to one side or the other, but that's all.

In addition to its excellent stability qualities, frequency readout is extremely linear. When you zero in on the nearest 100 kHz point and set the vernier logging scale, you can read the frequency directly in kilohertz. With a little practice you can interpolate to within about 100 Hz. If a DX station says that he's listening on 14206 kHz, you can hit it right on the money with no effort at all.

Other new, more subtle features of the Mark 2 are 400 watts on SSB, sidetone audio for CW, optional CW break-in and an

optional CW filter. Many of the transceivers on the market leave a lot to be desired for the CW operator; not so with the Mark 2. With the break-in and filter options, and the built-in sidetone feature, it's a dream to use on CW.

If you have ever tried to work the CW section of a DX contest, or tried to snag a rare one in a pileup on twenty meters, you know exactly what I mean. The if filters designed for sideband just don't do the job on CW. However, the optional new Galaxy F-3 filter provides the extreme selectivity required in CW work. The selectivity is nominally 300 Hz wide at the -6 dB points, with some broadening as the signal level increases. In fact, the selectivity is adequate to split the mark and space signals from an RTTY signal shifting only 170 Hz! To compensate for insertion losses, a one-stage transistor amplifier is built in. With this little nicety it is possible to switch the F-3 filter in with no change in the audio output.

Transmitter circuit

In the Mark 2 the microphone signal is amplified by two transistor audio amplifiers and then applied to a 12AT7 balanced modulator. A carrier signal from a 6GX6 crystal-controlled carrier oscillator is also coupled into the balanced modulator—the frequency depending upon which sideband is selected, upper or lower. The output from the I2AT7 is a double sideband, suppressed carrier signal.

This D.S.S.C. signal is coupled into the six-crystal lattice filter. This filter is only 2.1 kHz wide at 6 dB down and its excellent shape factor results in a very clean SSB signal with unwanted sideband suppression of at least 55 dB. The SSB signal from the output of the filter is amplified by a 6EW6 if stage and then coupled into a 6EI7 transmitting mixer.

The 5.0 to 5.5 MHz signal from the VFO is coupled directly into the transmitting mixer stage for operation on 20 and 80 meters. On 40, 15, and 10, a signal from the high-frequency crystal oscillator is mixed with the VFO output in a 6EA8 mixer and then applied to the 6EJ7 transmitting mixer. This signal is coupled into the 6GK6 driver—then to the parallel 6HF5 output stage.

For CW operation the carrier oscillator is shifted so that the carrier is centered in the bandpass of the crystal filter. This is helpful because you are transmitting on exactly the same frequency where you're listening, and not hopping across the band with every "over." In the CW mode, the 6EJ7 transmitting mixer is grid-block keyed.

The internal ALC system consists of two semiconductor diodes in the final grid circuit. Whenever grid current flows in the power amplifier, it is rectified and coupled as a negative ALC voltage to the 6EW6 if amplifier, reducing the gain to maintain linearity.

Receiver circuit

In the receiver the incoming signal is amplified by a 12BZ6 rf amplifier and then coupled into a 6HG8 receiving mixer. The mixing signal is supplied by the same VFO and 6EA8 mixer used in the transmitter. The output of the mixer is fed into the crystal filter and then to a 6EW6 if stage. It is further amplified in the second if amplifier, a 12BA6, and coupled into the 6GX6 product detector. The low-level audio output from the product detector drives the solid-state AVC rectifier and audio amplifier stages. The negative AVC voltage is applied to the rf stage and the first and second if stages.

Galaxy V Mk 2 Specifications				
Frequency coverage:	3.5-4.0 MHz, 7.0-7.5 MHz, 14.0-14.5 MHz, 21.0-21.5 MHz, 28.0- 28.5 MHz, 28.5-29.0 MHz.			
Types of emission:	Selectable upper or lower sideband, CW.			
Power input:	400 watts PEP SSB, 300 watts CW.			
SSB generation:	Crystal lattice filter, bandwidth 2.1 kHz at 6 dB points. Un- wanted sideband sup- pression —55 dB. Carrier suppression —45 dB.			
Receiver sensitivity:	0.5 μV for 10 dB sig- nal to noise ratio.			
Features:	Push-to-talk or optional VOX, ALC, automatic carrier insertion for CW, break-in CW operation with VOX accessory, grid-block keying on CW, tuning dial with vernier logging scale provides 1 kHz frequency readout—interpolation to within 100 Hz, optional 300 Hz CW filter.			
Tubes and semiconductors:	12 tubes, 16 transis- tors and 9 diodes. Parallel 6HF5's in			
Accessories:	the power amplifier. AC35 117 Vac power supply, G35A 12 Vdc mobile power supply, remote VFO, crystal calibrator, F-3 CW filter, VOX.			
Size and weight:	filter, VOX. 6" x 10¼" x 11¼". 13 pounds.			
Price:	\$420.00.			

In the optional VOX unit, an audio signal is picked up at the second speech amplifier and fed into a two-stage VOX amplifier. The output of the VOX amplifier is used to drive a Schmitt trigger. The base to emitter junction of a transistor is used as a level reference zener diode in the trigger circuit. When the input reaches the level preset by this diode, the trigger quickly conducts and drives a relay amplifier. The trigger circuit is much more positive than the usual VOX

circuitry and minimizes undesirable relay chattering. In the CW mode the keying circuit operates the sidetone oscillator which injects a strong audio signal to operate the VOX for break-in operation.

When you combine all of these features with a $0.5 \mu V$ sensitivity for 10 dB signal to noise ratio, selectable sideband, 400 watts PEP and complete five-band coverage, including a full megahertz on 10 meters, you have an all-around transceiver that is hard to beat.

. . . W1DTY

The Transistor: A Primer

It is inevitable that successful new devices such as the transistor are the subject of controversy, the victim of misconception, and the target of sour-grapes-type tube guys who are poor losers. Now we've got to go back to year 1 and clear the air so that both the neophite and the hoped-for converts will understand the transistor's history, it's uses, and its limitations.

- 1. It is not true that transistors were invented by a fashion plate and thief because the tubes he stole made his pockets bulge and ruined his crease.
- 2. The question, "Where are transistors found"? is somewhat a contradiction in terms. Once a transistor is lost it stays lost.
- 3. The practice of plating transistors with precious metal and using them as shirt studs and cuff links was a natural outcome after the discovery that they cannot be found if they roll under the bed or the bureau.
- 4. It is not true that the Japanese make transistors because they don't know how to make tubes. They simply don't have room to make tubes.
- 5. It is not true that Japanese transistor rigs are packaged by their fishing industry and the parts are not packed like sardines. Soy bean oil, cottonseed oil, mustard sauce, and catsup are all corrosive to transistors. At least the transistors have not appeared with every other one inverted on the board.
- 6. It is not necessary for the casual experimenter to stock a multitude of transistors for his home projects. You usually find only two types on his bench; the ruptured junction PNP and the open collector NPN.

- 7. Transistors are definitely interchangeable. The problem is to get them exchangeable at the store where we got them.
- 8. No, we don't have a sample transistor to show you. We did have but lost it on the way here.
- 9. No, dropping a transistor is not harmful. It always finds a soft spot in your cuff where it is lost.
- 10. Yes, we can define the words, "epitaxial planar passivated". They are discouraging words.
- 11. No, do not use RG-8U to interconnect monolithic chips containing 60 transistors and diodes. Use 5U4's (in the darlington connection for transistors) instead to benefit from the large signal handling capability.
- 12. Yes, if you repair a transistor rig and have to leave the vtvm connected to sustain oscillation, you can charge the customer for the vtvm.
- 13. Yes, the boxes that transistors come in where designed to contain transistors—why do you ask?
- 14. No, there is no shock hazard involved in servicing transistor rigs other than the initial one upon removal of the cover and having peered inside.
- 15. Yes, transistors last a lifetime. They usually survive the serviceman who works on them since he usually shoots himself by-and-by.
- 16. No, this isn't a biased opinion. That depends upon what you mean by bias. I used to know but I don't any more.
- 17. Watch it! Don't anyone move. No, this isn't a stickup. I just dropped my last 2N697.
 - . . . Raymond Stellhorn WAØNEA

Resurfacing Plastic Faces on Meters

Did you ever try to take a reading by squinting through the face of a meter that has been marred by a molten drop of solder? I did for a long time until I decided to sell the instrument and found that I could not even give it away because of that ugly mark. Since I could not lose anything, I decided to try and fix it.

With some very fine steel wool, I rubbed the whole plastic face in such a way as not to leave any noticeable gouges and the face was evenly frosted. When this was done the face looked like the inside of a frosted light bulb, and the mark left by the solder had disappeared. After this operation I sprinkled a bit of powdered kitchen cleanser on the face and rubbed it on with care, avoiding any large grit. After a few minutes of this, the face became clear again, and a final buffing with a cloth did the trick. To prevent any static electricity from affecting the accuracy of my meter after this work, I spread a thin film of a liquid dishwashing detergent on the face of the meter and let it dry. Now my meter looks like it did when it was brand new. I found that this also works well on wristwatch crystals.

. . . E. Babudro VE3ECU

Testing Silicon Diodes

It has been my fortunate experience to have acquired a number of silicon diodes as well as signal diodes and transistors. The problem of course is to evaluate these units so as to make proper use of them without exceeding their inverse peak values, i.e., non-destructive testing.

The first problem was in obtaining a burnout proof micro-ammeter. Surveying the equipment on the bench I spotted a VTVM. A little further thought led me to realize this was exactly the instrument I searched for. Its input resistance is 11 megohms and in operation it is actually measuring the current through this resistance. All this means is that for each 11 volts read on the meter there is 1 microamp of current flowing through the meter. 10 microamps-110 volts etc. Therefore: using a VTVM for a dropping resistor in conjunction with a variable voltage dc power supply of on the order of 1000 volts, it is possible to "avalance" both diodes and transistors without damaging them.

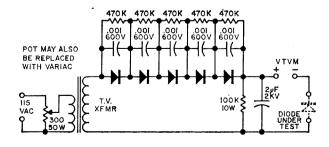
In evaluating silicon diodes for high-voltage power supplies, etc., the diodes should have less than 1 microamp of leakage. The maximum peak inverse voltage that can be safely used on a particular diode would be that voltage with produces 1 microamp of leakage or less. This would be the diode's "PIV" rating.

It has been said that once a manufac-

turer sets up his equipment to make "good diodes", it's fairly difficult to make poor ones. That is to say that a great many 200 volts PIV diodes have actual PIV ratings of 600 volts and some even better.

In using these diodes for high-voltage power supplies there are several rules which should be rigorously adhered to. 1. There should be a .001 µF disc capacitor across each diode. 2. There should be approximately % meg resistor across each diode in the string. (These resistors equalize the reverse voltage drop across each diode compensating for individual leakage resistances. The capacitors tend to round off most high voltage transients from the power line). 3. Allow, at least, 20% safety factor in initial design, i.e., a 2400 volt dc supply with 2400 volts AC each side of center has a inverse peak voltage of 6720 volts. 2.8 X 2400. With 20% safety factor the diodes should be capable of with standing 8024 volts. Ref: 37th Edition ARRL handbook, page 221.

... John McFeters KØOLG





Mort Waters W2JDL 82 Boston Avenue Massapequa, L. I., N. Y. 11758

The Heathkit SB401 Transmitter

Companion to the SB301 receiver reviewed here last month, the SB401 is, like its partner in receiving, a modified and improved version of an older piece of gear, in this case the SB400, an exciter which lost no time in establishing a good reputation.

Frequency coverage is from 10 to 80 meters in eight 500 kHz segments, four of which are required for the full spread from 28 to 30 MHz. The operator has a choice of upper or lower sideband and vox activated CW on all frequencies.

Circuit

Make no mistake—nothing's missing from the SB401. A fistful of controls make you master of any situation. Tracing out the circuit will make this clear.

Audio input, either high-impedance mike or phone patch, is applied to the grid of the preamplifier, half of a 6EA8. Audio response is shaped to restrict bandwidth to 350 to 2450 Hz, plus or minus 3 dB. The amplified signal goes through a capacitor and level control to the other half of the 6EA8, a cathode follower.

In either of the SSB positions—upper or

lower—audio from the 6EA8 is also applied through the vox gain control to the vox amplifier. When operating CW, however, a 1000 Hz sidetone is generated by a 6J11 tone generator and amplified by a 6D10 tone amplifier; this feeds the grid of the vox amplifier, allowing vox to be used in all modes. Output from the vox amplifier is rectified by a diode and coupled to the grid of the relay amplifier. Vox sensitivity and drop-out time are adjustable, as is anti-vox level.

In addition to keying the vox amplifier, the tone oscillator also provides a monitoring sidetone. This can be obtained by feeding the receiver audio into a rear panel jack on the transmitter, then plugging the station loudspeaker into another jack. Thereafter, the received signal is heard normally until the transmitter is activated; at that point, the receiver is muted and the sidetone is heard in the speaker instead, each time the key is closed—a very convenient arrangement which will be appreciated by CW hounds. A level control inside the cabinet, but easily accessible, adjusts sidetone volume.

A triple-triode Compactron, a 6AV11, is used as follows: one triode is the lower

sideband carrier generator, at 3393.6 kHz. Another triode section is for the upper sideband carrier at 3396.4 kHz, and in the CW mode, uses another crystal at 3395.4 kHz. Only that triode selected by the mode switch receives plate voltage. The third triode is a cathode follower in all modes.

Audio from the speech-amplifier cathode follower and carrier from the sideband generator are fed to a diode ring balanced modulator whose output is the sum and difference of the audio and carrier frequencies. When operating on CW, a small dc voltage upsets the balance of the modulator, producing output on the CW carrier frequency.

The signal is then coupled through a transformer to the grid of a 6AU6, which isolates the balanced modulator from the crystal filter and provides for the proper impedance matching. This stage is also partially controlled by ALC (automatic level control) voltage which will be mentioned later. From the isolation amplifier, the signal next goes to a 2.1 kHz crystal lattice filter, emerging to be coupled to the grid of the 6EW6 mixer.

The SB401's VFO operates over a range of 5 to 5.5 mHz, its output passing to the cathode of the 6EW6 mixer, which produces the sum and difference of the VFO and previously generated frequencies. The sum frequency is then coupled through a bandpass coupler (8.395 to 8.895 MHz) to the grid of the heterodyne mixer, another 6EW6.

The triode portion of a 6AW8 is a heterodyne oscillator whose plate voltage is regulated, and whose frequency is determined by one of the eight switch-selected crystals. Its output is also coupled to the grid of the 6EW6 heterodyne mixer. In passing, note that the sole function of the pentode section of the same 6AW8 is to amplify the heterodyne oscillator input from the companion receiver, the SB301, when operating transceive. Only when the mode switch is in the "transceive" position is plate voltage applied to this part of the tube. In the "independent transmit" posiion, voltage is applied instead to the plate of the 6AW8 heterodyne oscillator.

The signals from the bandpass coupler and heterodyne oscillator are mixed in the 6EW6 heterodyne mixer. Only the difference frequencies reach the grid of the 6CL6 driver tube. A trap in the driver grid suppresses a spurious signal at 8.6 MHz which might otherwise appear in the output on the 7 MHz band.

Driver output is applied to the grids of a pair of 6146's in parallel, operating in Class AB₁. An internal pot sets bias at -50 volts to hold the no-signal plate current at 50 mA.

Peak driving voltage for the finals is variable with the CW level control, which is in tandem with the microphone gain on the front panel. In SSB operation, the limiting action of the ALC circuitry also affects the driving voltage.

A conventional pi network couples final output to the antenna. Impedances of approximately 40 to 150 ohms can be matched. A built-in relay automatically transfers the antenna from the transmitter to the receiver.

GD 401 G 'C '					
	Specifications				
Frequency Coverage:	3.5 to 4.0; 7.0 to 7.5; 14.0 to 14.5; 21.0 to 21.5; 28.0 to 28.5; 28.5 to 29.0; 29.0 to 29.5; 29.5 to 30.0 MHz.				
Emission:	Selectable upper or low- er sideband, CW.				
Input power:	180 watts PEP SSB, 170 watts CW.				
Output power:	100 watts on 80 through 15 meters; 80 watts on on 10 meters.				
Output impedance:	50 to 75 ohms.				
Frequency stability:	Less than 100 Hz drift per hour after 20 minute warmup period. Less than 100 Hz drift for 10% changes in line voltage.				
Sideband generation:	Crystal lattice filter. Carrier suppression 55 dB down from rated output. Unwanted sideband suppression 55 dB down from rated output at 1000 Hz and higher. Third order distortion 30 dB down from rated PEP output.				
Dial accuracy:	Visual accuracy within 200 Hz on all bands; Electrical accuracy within 400 Hz on all bands after calibration to nearest 100 kHz point.				
Features:	Noise level at least 40 dB below rated carrier; audio frequency response from 350 to 2450 Hz; 10 dB audio compression; high impedance microphone and phone-patch inputs.				
Power requirements:	105-125 Vac, 50/60 Hz. 80 watts in standby; 260 watts CW (key down).				
Size and weight:	14%" x 6%" x 13%". 26½ pounds.				
Price:	\$285. (Optional crystal pack \$29.95).				

In either LSB or USB modes, when the final tubes are driven into grid current, a voltage appears at the junction of a resistor and capacitor in the final grid circuit. This voltage, which follows the audio peaks, is rectified by a pair of diodes and appears on the grid of the 6AU6 isolation amplifier as a bias. Thus, should the finals be overdriven, gain is reduced immediately to prevent splatter. In one of its several switchable positions, the panel meter displays the ALC voltage. By keeping an eye cocked at it, drive may be effectively controlled by holding voice and gain at the level where the needle stays where it's supposed to.

The meter also reads final grid and plate current and plate voltage, as well as relative output and is very useful in tuning up and operating within the proper parameters.

The lineup is completed by a solid state power supply furnishing 720 volts dc under full load of 250 mA. Lower voltage dc—250 volts—is also provided for other stages, and there is -170 volts of bias too.

Comparison with the SB400

The major difference between the new rig and its rather young ancestor is "instant transceive". Owners of the SB400 will recognize the value of this new feature immediately; you no longer have to open the cabinet and change the output cable from the VFO to switch modes. It was never a big deal to do so, but there's no doubt that the convenience is well worth having. So many SB400 owners have home-brewed conversions that will do the same thing that a number of articles have already found their way into the magazines. At least one unpublicized version this writer knows of (K2UUJ fathered it) was based on the fact that the heterodyne oscillator is activated only in the transceive mode. The plate voltage was picked up at a convenient point to power a relay that performed the actual switching of cables. Other schemes have been used successfully.

An added driver coil is an important but less noticeable improvement which results in more 10 meter drive. The single driver coil in the SB400 was tuned for 28 MHz. As a result, drive was insufficient in the upper reaches of the band. Now, with the extra coil peaked at 29 MHz switched into the circuit better results are assured.

The VFO mixer stage, although still us-

ing a 6EW6, has been completely revamped. Even a casual comparison shows the difference at once. A 21.1 MHz trap is now included in the circuit. There are many minor revamps elsewhere; the mere fact of their existence is a pretty good indication that the boys at Benton Harbor are satisfied with nothing but the ultimate and continue to improve their product even when it is already well accepted.

As further evidence of this thinking, the SB401 has a 680 ohm resistor inserted in the screen voltage supply to the finals. It has been added because it reduces the already acceptable distortion products figure by 3 to 4 dB more.

Although the SB400 was designed to operate independently or transceive with the SB300 receiver (which it will also do with the new SB301), it was sold only as a complete unit. With the advent of the SB401, however, Heath has changed their marketing strategy and made the rig even more of a bargain for those who own the receiver. The new model is available complete, as before—which is what you'd need to use it with any other receiver—but, if you own either the SB300 or SB301, you can buy the transmitter for less without the crystals which are sold as a separate accessory.

The new transmitter's VFO has been modified, just as it was in the transition from one receiver to another. Minor circuitry changes and use of an industrial type 6BZ6 instead of the old 6AU6 is the story. At the risk of boring those who may have read the review of the SB301, this seems to be gilding the lily, because the original VFO was rock steady. The new one is at least as good, if not better.

Other minor but noticeable changes . . . a different type of socket on the rear panel to provide line voltage ac to operate external relays; the use of two terminal boards smaller than used in the SB400 for below chassis parts mounting, cleaning things up nicely.

Construction, alignment and operation

A total of 37½ hours was spent building the transmitter, including about two hours for photography. Alignment, for which you need a VTVM with an rf probe, a ham band or general coverage receiver, and a dummy load, took about 3 hours more.

Would-be builders may benefit from these suggestions:

Before soldering any connections from the cable harnesses, lay them in the most advantageous position. Twisting them here and there will make for a neater job. Take this precaution—where the manual specifically instructs you not to shorten leads breaking out of the harness, don't. Hear and obey!

Make every effort to achieve proper alignment of the dial mechanism. Set up right it is as smooth as the expensive spread; if not, it shrieks, groans and otherwise suffers.

Once construction, alignment and calibration are finished, you can begin to enjoy the fruits of your labor. This transmitter is everything you could want. SSB buffs will be proud of their clean, splatter-free signals, excellent suppression, freedom from drift, and natural audio quality. The vox is smooth and can be adjusted from instant dropout to holding in long enough so that you'll never know you worked Don Miller. This is no gag—I found myself cutting its hold-in time for fear I wouldn't hear his rapid-fire comebacks.

Brasspounders will revel in the clean, chirp free T9X note, to say nothing of the convenience of the built-in sidetone and voxactivated break-in keying. The scope in my shack displays a signal which is shaped good, like a CW signal should.

Add the undeniably good looks of the package, the fractional kHz readout, and you've got quite a piece of equipment.

Final comments concern transceive operation with the SB300 or SB301. Numerous interconnecting cables are required, as expected, but three of them—those which bring the VFO, BFO and heterodyne oscillator signals into the transmitter—must be cut from RG62 coax cable to exactly 2 feet. The cable is supplied with the kit.

When the transmitter and receiver are interconnected and CW operation is desired, the transmitter's mode switch should remain in the "transceive" position at all times, whether actually transceiving or operating split frequency. If the mode switch is set instead to the "transmit" position for CW, a constant beat note is heard in the receiver. This isn't too clear in the manual and it took a personal discussion with the Heath engineers before it was cleared up. As a result, they have issued a bulletin to clarify the matter, and are including a revision in current production. This also applies to the SB300/400 combination. . . . W2JDL



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FOR CLOSED CIRCUIT OR AMATEUR TV

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- Weighs 3½ lbs.
- Operates on 100-130 volts 50 or 60 cycles, 7 watts.
- Tested at 10° to 125° F.
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- Field effect input circuit for minimum video noise.
- Resolution guaranteed to exceed standards set by 525 line TV receivers.
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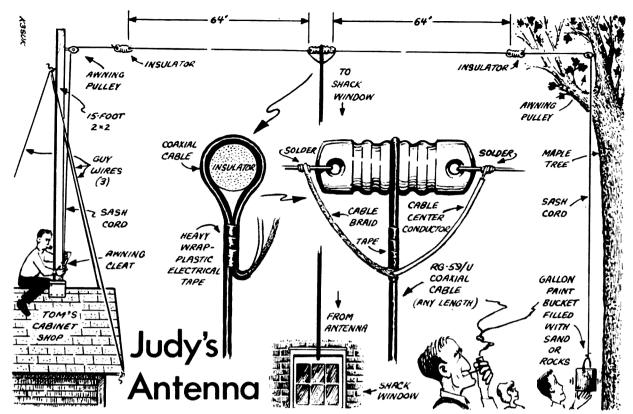
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Climbing the Novice Ladder

Part VIII: Approaching the pinnacle of final achievement.

Five days after mailing her order, Judy's little Adventurer transmitter arrived; two days later Joe's Knight-Kit T-60 was delivered to his door. Judy immediately coaxed her Dad into taking her out to FN's place as FN had agreed to put her little rig on the air and give it the acid test. When they arrived, FN took the transmitter, set it on his bench and ran his eagle eye over it. "Looks pretty nice Judy . . . not a single scratch and no paint chipped . . . I'd say the former owner had given it good care. Let's hook her up to my test antenna now and see how she loads up." Using clip leads from the antenna and ground terminals on the rig to the terminal screws on his bench, FN plugged in his key, went in his shack, turned on the receiver and put it on the speaker. "We can't legally make an on-the-air test Judy, without signing our call letters at least every ten minutes. As you're not yet licensed, I'll have to do the actual keying of course and I'll use my own call letters. I put the receiver on in the shack so we can ask "QRM?" occasionally and we can then hear anyone whom we might be bothering on the frequency. Lucky I've got quite a store of crystals here; that's one thing we all overlooked when you ordered the transmitter; should have told you to order at least one crystal in the novice band at the same time." "I thought of that Gramps," Judy replied, but it slipped me when I placed the order. We won't have to

send for a crystal though; all three stores down-town have a pretty fair stock including novice crystals so we can get one there; Joe will need one too." "That's right, Judy, and I suggest that you both get just one for the 80 meter novice band for a starter. Get a frequency well removed from either end of the band to insure that your operation will be well within bounds. Check at the club and see what frequencies other local novices are using. You can then get one a little off from any of those and you won't interfere with each other then but you can still communicate back and forth. For the tests we're going to make now though we won't need a novice band crystal as my Extra Class License gives me all amateur privileges, but let's pick a crystal as close to the novice band as my stock will produce. Let's see . . . here's one at 3520 . . . too low . . . 3610 . . . still a bit low . . . ah, 3685 . . . that's only 15 kilohertz from the low end of the novice band . . . let's give that a try" and so saying, FN plugged it in. "Now you can plug the AC cord into the outlet Judy . . . wait a minute . . . check the 'on-off' switch on the panel first Judy . . . be sure it is 'off'. That's right; now turn on the switch. The pilot light comes on and we can see the glow of the tubes through the vent holes in the cabinet . . . so far, so good. Let 'er 'cook' for a few minutes to warm up the tubes and then if no smoke, we'll tune 'er up." In a couple of minutes FN asked for the instruction manual and



Judy handed it to him. "I'm looking for the tune-up instructions Judy; I know what to do but I want you to follow it in the book as I make the adjustments. First we'll put the band switch on 80 and the meter switch on 'grid'. Now we'll tune the oscillator dial until we get a maximum reading on the meter; this is the 'drive' to the grid of the final amplifier tube. Next we flip the meter switch to 'plate' and quickly tune the final amplifier dial, leaving it at minimum point at which it dips. We do this quickly so the current doesn't run away . . . could damage the meter or tube or both if we make a sluggish operation of this. And, I noticed but forgot to mention that the 'load' switch was already in the minimum position which it should be. There . . . see how great a difference in meter reading when you hit the dip point? From almost off scale the pointer fell clear back to about 30; good. Now we want about 100 on the meter . . . that's 100 milliamperes or normal load for the 807 amplifier tube. So . . . we'll advance the loading adjustment switch one point at a time. As we do the meter reading will go higher each time. We bring it back to the dip point with the final amplifier tuning dial . . . see? Notice that the dip point is now 45; we can load still more; let's take another step on the load switch, again dipping the final. Now

we're reading 60; let's load it another point; ah, now we're getting close . . . reads slightly above 80 now; one more point. There, that's so close to 100 that we'll leave it . . . about 97 I'd say. The next point on the load switch would probably take it well over 100 which would be an overload on the tube which we don't want. As a final adjustment, we flip the meter switch to 'grid' again, and with the oscillator tuning dial, adjust the current so that it reads not more than 4 on the smaller scale; that's normal for the 807 tube. Finally, touch up the final amplifier dial if necessary to establish the dip point which should still remain around 95 to 98 . . . it does. Let me light my pipe now and then we'll send a few V's and my call, ask "QRM?" and listen to the speaker for a minute." After coaxing a few billowing smoke clouds from the old corn cob. FN made several V's . . . the generally accepted test signal, made the word 'test', asked "QRM?" and signed his call. Except for background noise and a little static, all was quiet from the speaker; apparently no interference was being caused to others. "Now," said FN, "suppose we try a 'CQ' call and see if we can raise anyone. Relax Judy, you're as tense as a fiddle string." FN laughed and turned to her Dad saving. "You too, Tom; you'd think we were about

to set off a dynamite blast!" Both Tom and Judy released a deep breath which broke the tension somewhat while FN slowly and carefully made a conventional CQ call with the key. "Now Judy, let's go in the shack and tune around the frequency a little bit on either side; chances are against us raising a novice as we are outside of their band but one of the VFO equipped General class guys may answer pretty close to our frequency." FN tuned about 10 kilohertz either side of his crystal frequency but no response. He said, "OK, let's try again now and when I'm through calling, you tune around on the receiver Judy and see if we get a bite." Repeating the earlier process brought only silence in the speaker and Judy 's face fell a bit. Seeing this, FN bolstered her spirits a bit with, "Think nothing of it girl . . . not too many stations on in the daytime you know, but we'll give it another whirl; they say the 'third time is the charm'."

Once more the general call to anyone to answer . . . CQ . . . went out then Judy carefully tuned the receiver. "Whoah," called FN as she crossed a relatively loud carrier slowly making code, "back up and tune him in." As she did FN said, "He's calling us Judy; you get it?" "Oh no Gramps, I'm too excited to figure it out" to which both Tom and FN laughed. "Try writing down what he says anyway Judy" FN said as he listened to what the slowly sending station was saying. When the other station had completed his call, FN went back on the key equally slowly, gave him his signal report, FN's location and his sine then told him, "Just making a test here OM; can't stay with you this time but would like a signal report and your QTH and name please." Back came the other fellow, FN acknowledged and thanked him and then signed off with a "73." "Well Judy," FN queried, did you copy any of it?" "Well" she replied, "I got some of it but not enough to really make sense; what did he say Gramps?" "First off he gave us a signal report Judy; RST 579 . . . not bad. That means our signal was easily readable at strength 7 . . . 9 is maximum . . . and we have a good crystal note. Then he told us that he was in Beaver, Pennsylvania . . . that's just across the Pennsylvania-Ohio state line . . . about 200 miles from here roughly. Not exactly 'DX' but it's a good start. Now let's see what I've got in a forty meter crystal and we'll try for a contact there.

Here's one right in the novice band . . . 7190 . . . where'd I get that I wonder? Let's try it." Crystals were quickly changed, the band switch set to 40 and the tuning process repeated until the antenna and tube were properly loaded. After setting the receiver to the same frequency as the transmitter crystal, FN put out a slow 'CQ.' Better luck this time . . . an answer on the first call and almost on the same frequency. When the distant station had completed his call FN announced, "Judy, we've raised a novice in the 7th call letter district . . . that's way out west; this little rig looks like it was going to do it's stuff in great shape." FN answered the call with the usual preliminaries then listened while Judy attempted to put down the return reply on paper. Much to her surprise and delight she got both his name, 'Paul' and his location in Cody, Wyoming! She missed the signal report figures but FN told her, "579 again, Judy; that's as good as we got from Pennsylvania. Wyoming is some six or eight hundred miles from here but remember, 40 meters is a better band for long haul contacts than 80; we're doing fine though. Now the only other novice band you can work is 15 meters but I don't have a crystal for any part of that band . . . seldom work it and when I do I use the VFO. No matter though; we've done enough to prove that the little Adventurer can dish it out. Why don't you leave it with me for a few days? You don't have your license yet so you can't use it and that way I'll have a chance to try it out with my regular dipole antennas and several crystals." "Fine Gramps: like you say, no need for me to just sit and gloat over it at home until I get my ticket so you go ahead and use it and see how much DX you can pile up" Judy laughed. "I wouldn't laugh yet Judy," FN returned, "you might be surprised at all the foreign contacts I might make." Judy looked a bit dubious but accepted FN's statement with, "Hope you do, Gramps . . . wish I could."

The little Adventurer having demonstrated it's worthiness, was then turned off for the present and FN turned to Tom saying, "Tom, you and Judy bought 100 feet of antenna wire and a couple of insulators for your temporary antenna a little while back. Why don't you get another roll of antenna wire . . . fifty feet will be more than enough this time . . . and another insulator and I'll drop over in a day or so and show you and Judy how to make up a good dipole antenna

which will really give Judy's transmitter and receiver a chance. You will need an antenna about 130 feet long with an insulator in the center and some coaxial cable for a 'feeder' line from the antenna to Judy's shack. You can use the antenna wire you already have as well as the two insulators, and the extra wire and insulator will let you lengthen the sky wire and insulate it in the middle; I'll show you what it's all about when I come over. Wait till then before you get any coax cable too as we'll have to figure where you're going to hang the antenna and estimate the length of coax we'll need . . . it's sold by the foot so we won't have to waste any . . . the stuff costs about a nickel a foot. I've got a lot of surplus coax connectors so we won't have to get one for the transmitter end of the feeder. And by the way Tom, how you coming with learning the code yourself?" "Well Dad, Judy says I'm catching on but I don't have too much time to practice you know. Judy sends to me for awhile each evening and I'm beginning to recognize a lot of the letters now. I'm doing a bit of reading in her ABC's book and the License Manual too, and they both are beginning to make a bit of sense now. I'll make it before long . . . you'll see." Then, with appropriate farewells, he and Judy climbed in the station wagon and headed homeward; Tom would pick up the wire tomorrow.

That evening Judy phoned Joe to tell him of the arrival of her transmitter and results of the tests at FN's shack. "Gee, Judy, that's swell" Joe commented. "My rig hasn't come yet but I expect it any day now." Then Judy told him that FN was coming over to show her and her Dad how to make up and hang a good antenna. "Dad's getting some more wire and insulators in town tomorrow and then Gramps will help us." "Gee Judy," Joe came back, "how about me getting in on the antenna deal too? I'm going to have to have a good one too you know. I've just been using an old hunk of lampcord in the attic for my receiver but I'll need better than that for the transmitter." "Sure Joe," Judy replied, "I don't see why not; I think Gramps is coming tomorrow afternoon but you'd better phone him to be sure. We can all work on it together and we'll all learn something." "Swell Judy; I'll give FN a call and we'll fix it up." "OK Joe, see you at the Judy Mansfield antenna farm then" was Judy's laughing rejoinder as she hung up.

Tom had picked up the wire and an insulator the next morning and FN had confirmed to Joe that he would be out at Judy's in the afternoon, so shortly after lunch the little group gathered. The first order of business was to decide where to stretch the antenna, and while Tom had a rather hurryup kitchen cabinet project in his cabinet shop he was agreeable to taking a little time to do a bit of looking with them and catch up on his shop work in the evening. His shop was about 75 feet behind the house where Judy would have her shack in her room. About 60 feet from the front of the house a stately maple tree rose about 50 feet. To FN this seemed a natural. "Tom" he said, "you can stick a 15 foot hunk of 2x2 on the ridge of your shop with three light guy wires and that will make a good support for one end of the antenna and will put it about 35 feet above the ground . . . that's a good height. Then you can stretch the antenna between this mast and the maple out front . . . that's about 180 feet; all we'll need for the antenna is about 130 feet but we'll fix that by hanging the antenna itself in about the middle of the stretch and let the hoisting rope take care of the extra length. If you're willing to put up a stick on the shop for one end, I'll make up a dimensioned sketch from which to build the antenna. Put an awning pulley and a length of sash cord on the top of the mast, remember, and we'll need the same in the tree so I'd better get a couple of pulleys and a hank of sash cord while I'm in town. I'll pick up the coax cable for you too, then you can go right ahead. That sound OK to you?" "Yeah Dad, I've got lots of 2x2 stock in the shop and plenty of galvanized fence wire to use for guys. I'll make up a little saddle for the roof ridge and if Joe can stick around, maybe we can get the mast up yet todav . . . it's still early . . . how about it Joe?" "Sure, Mr. Mansfield," Joe replied, "I'd like to help; let's do it." FN, satisfied with the arrangements, madeup a rough sketch of the antenna make-up which they could do while he did a few errands in town, jumped in his Jeep and took off.

By 4 o'clock FN was back and found that the antenna 'crew' had made good progress. Tom was ready for the rope and pulley for the short mast and he and Joe made short work of erecting it in place. Joe, with the agility of youth, skinned up the old maple for about 35 feet and soon had the



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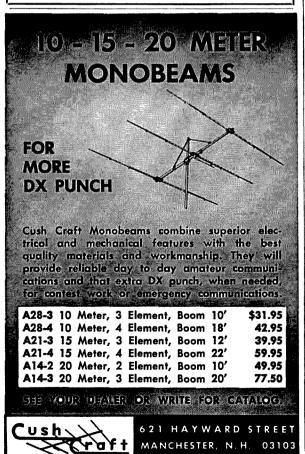
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rope and pulley fastened in place, came down and prepared a gallon paint bucket full of sand for the lower end of the hoist cable. In FN's absence, Joe and Judy had taken down the old antenna and had one of the antenna legs laid out and spliced into both insulators. "Well," FN commented, "good team work. You people have done such a fast job I think I'll stick around and see it finished . . . I don't have to be home for another hour or so and it looks like vou'll have her swinging in the clear before then." With this he uncoiled the coax cable he had brought and showed Judy how to attach it to the center insulator while Joe made up the other leg of the antenna. After soldering the joints at the center insulator, FN pronounced the sky-wire ready to hoist and with Tom on the shop roof and Joe at the base of the tree, the antenna was hauled in place with Judy keeping the coax feeder free from obstructions on the house. "There you go" said FN, when the hoist was completed, "a good looking, workmanlike job you've made of it and it'll work as well as it looks. I'm going to be pushing off for home now, but Tom, you can drill a small hole in the window sash of Judy's shack and push the coax feeder through. Judy can skin the end and hook the braided shield to the ground post on her receiver and the center conductor of the coax to the antenna terminal. You'll see guite a difference in the performance of your receiver Judy, but don't forget to adjust the antenna trimmer on the receiver to resonate with this new antenna." "Gee Gramps, thanks so much," Judy exclaimed. "I hadn't expected we'd finsh the antenna job today and I'm going to have a lot of fun listening around this evening." "Yes Judy, that's all you can do now until your license comes, so make the most of it. Joe, what about your antenna?" "Oh. I'm going to stop at Jim Turner's on the way home and pick up the wire and stuff and Larry and a couple of the guys from the club are coming over Saturday to help me put up an antenna. Gee. I'd better get going before Turner closes" and so saying Joe took off; FN was not far behind him as he drove off in his Jeep.

. . . W70E

Next month: Judy and Joe reach the top rung of the ladder. They receive their licenses and are well launched on their novice career with some pertinent advice from FN.

Type N Connector for the APX-6

Tired of fighting with the type HN connector that comes on the front panel of the APX-6? Well, contrary to popular belief, it's relatively easy to change it over to a more conventional type N fitting. The whole operation only takes fifteen or twenty minutes and is well worth the effort involved.

First of all, remove the tuning knobs, pull out the tubes and remove the five screws holding the cavity assembly to the front panel. Remove all the screws that hold the cathode cavities to the rest of the cavity assembly; remove these cavities and the spring finger gasket underneath. If you look into the top of the T-R cavity, you will see a coupling loop into the transmitter cavity and the large round lead going to the coaxial connector.

The connector is held to the cavity by a split collar; it may be loosened by simply removing the screw which runs through the side. When this screw is removed, you should be able to rotate the connector in the collar. If you unsolder the connector lead from the coupling loop, the connector may be completely removed.

A type N cable jack, the UG-23D/U, fits nicely into this collar. A piece of %" brass tubing from the hobby shop is used for the lead to the transmitter loop. Cut a piece of tubing 1 ½ inches long and solder it to the center pin on the N connector. Discard the braid washer, gasket and nut from the connector; they are not required

for this application.

On the rear end of the N connector you will see two flats which have been machined into the body. One of these flats will have to be extended toward the rear of the connector for % of an inch; this will provide clearance for the screw in the retaining collar. The flat may be enlarged with a few strokes of a good sharp file. Install the pin and brass tubing into the connector, insert the connector into the collar, tighten the screw and solder the tubing to the transmitter coupling loop. Make sure that the tubing has gone through the two holes in the loop.

If you don't want to go to the trouble of installing the type N connector, a more expensive solution is to use an HN to N adapter, the UG-1108/U.

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Gus: Part 25

In the very next apartment to Jack and Marge, ZS1RM and ZSIOU in Capetown, was the apartment of Jack's mother and father. They came over often and we had many chats about how things used to be in South Africa in the old days. Jack's father is now retired; he used to be a diamond buyer in Kimberly and knew the diamond business coming and going. His wife had some real dandies that I saw on her one night when she was going out to some sort of celebration. She had diamonds in her ears, around her neck, on her wrists, on her fingers, and a brooch or two just pinned on. I mean to tell you that none of them was a little old dinky 3 or 4 carat either. I immediately started calling her Diamond Lil. I tried my darndest to let her know that Peggy also loved diamonds, but I never did have any luck. I think she loved those diamonds even more than I did! When I was departing the country a few months later, I told her to be sure to put my name in her will!

Jack's father told me some very interesting stories about the diamond business; and about some of the very large ones that had been found years before. Also, some very interesting stories about people trying to slip out of the mines with diamonds. One was about a fellow trying to get out of South Africa and through customs with a big batch of diamonds. The story goes like this: someone tipped the customs officials that a man was leaving from the Jo-burg airport the next day, on flight number so and so, with his leg in a cast. The man claims the leg is broken, but in reality the inside of the cast is embedded with diamonds. The caller did not identify himself. Sure enough, the next day on that flight a man named Smith was pushed in a wheel chair up to customs; he had a one way ticket to Amsterdam, Holland. The customs people arrested him and took him into the little room they have there for such people. They very roughly tore and cut the cast from his supposedly broken leg. They were quite rough handling him and he was hollering his head off saying the broken leg was very painful and that he had nothing concealed in the cast. Of course, they didn't believe him at all, but when the cast was finally removed and examined there were no diamonds whatsoever. He threatened to sue the South African government for false arrest, painful injuries, delayed flight, and the works. The customs officers tried to excuse themselves for their mishandling of him; they even took him to a hospital and had his leg x-rayed—the bone was broken. They paid to have a new cast put on his leg. He said it was all OK; he knew that they had a job to do and that he would catch the flight tomorrow for Amsterdam. The next day he arrived at the airport, again in a wheelchair, the cast was on his leg and he left for Amsterdam—only this time the cast was loaded up with those diamonds. This was discovered later when the diamond market of Amsterdam was suddenly flooded with South African diamonds which were traced directly to the man with the broken leg.

Oh yes, Diamond Lil loved those diamonds and I never did get to first base in chiseling them from her! Later on, when I was in Kimberly, I was approached by someone on the street who had a handful of diamonds; he wanted \$1,000 for the lot. As a rough guess there were about five 1 carat stones, two or three 3 carat stones. and one or two that looked like 5 carat stones. I darned near bought those stones and would have become a diamond smuggler myself, but I just plain chickened out. Also, I did not want to spend \$1,000 of WRPSA money, possibly breaking up the entire DXpedition. I told Jack about this later on.

I asked Jack if those stones were the real stuff and he said yes, they probably were good ones; he added that if I had bought them the seller probably would have turned me in to customs, getting 10% of the actual value of the diamonds. The stones might even have been returned to him; he may have said I had stolen them from him. Then the \$1,000 would have been gone, the diamonds gone, me in jail, the DXpedition blown up and the WRPSA broke because the money was all gone. I am sure glad that I was raised right by my mother and father to not go around breaking the law. I would have been in very deep trouble I am sure;

to this day I could still be rotting away in some South African jail.

One night the entire SARL invited me down to their meeting in Capetown, where I met most of the Capetown group. I had a very fine dinner with them and stayed up late with one of those large eye-ball QSO's that I seem to be having all over. Every place I stopped there was a group of hams getting together.

The day of the ships departure was gradually drawing nearer and I was taking it easy at Tack and Marge's apartment. I had really moved in: running around in my stocking feet, visiting Jack's mother and father a few times each day, and walking around the Strand. Jack and Marge took me all around Capetown—I was getting so I nearly understood how to get from the city to their OTH without getting too lost. I even went downtown on the bus a few times and got back to their OTH on another bus without any trouble. When departure day was about 4 or 5 days away, we paid a visit to the Norwegian Consul to tell him about my proposed trip to Bouvet Island. We explained about the permission I had received through LA5HE to operate from there. Of course he knew nothing about it, but said he would get off a cablegram to Oslo and let us know what he found out. A few days later he telephoned to say that all was OK and the call sign I should use was LH4C-this was great! We then went to the ice breaker that was to carry me there and I was introduced to the crew of the ship. I could see that they were all fine fellows and looked as if they would be an easy lot to get along with-even though most of them were seasoned seamen and a pretty tough looking batch. They had all made many trips to this part of the world and they knew what we were going to be facing when we were in the South Atlantic with those icy cold gales from Antarctica tossing the ship around.

After a close inspection of the ship, and being shown where I would bunk, Jack and I left and returned to his home. We had received a phone call while we were away telling us both to be sure to come to the Capetown SARL meeting that night in downtown Capetown. All the hams from that area were there. As near as I can remember there were about 35 or so ZS1's on hand. They discussed the things that hams all over the world discuss when they get together. All the CW fellows said that I used too

much SSB; all the SSB fellows said I used too much CW. This is what a DXpeditioner has to face anytime there are meetings anywhere in the world, including the USA.

My system of operating from a rare spot has always been to start with CW and when there was a nice pileup going, switch to SSB and work them until the pileup grew small. Then go back to CW until the pileup grew low and then back to SSB. I like this system of operating and if I ever go on any more DXpeditions I think I would still use this system. The percentages of SSB to CW QSO's using this system usually ended up fairly close to 50/50 when the QSO's were counted after a stop had been finished.

I always stayed at any place I operated from long enough to give everyone a fair chance to work me. By this I mean at least one QSO on CW and one on SSB. I was sorely tempted a number of times to have a blacklist on account of some of the things I heard over the air and some of the unfair operating some of the fellows used. Then it crossed my mind that this was probably not being done knowingly. I well remember some of the things I had done on the air during pile-ups, in the excitement of the battle. I know I have been called a "lid" a number of times on account of some "dumb" thing I had unknowingly done. Lots of the fellows I have heard doing some of these same things I know personally and I know they are not the kind of fellows that they seemed to be on the air at certain times. I just did not have the heart to not hear them or to work them and forget to put their call signs down on the log page.

Maybe I am "chicken hearted", but I had made up my mind a long time ago that I would work every station I heard, ABSO-LUTELY no preferred fellows. Not even any preferred countries. I worked what I heard when I heard it. I can sincerely say that I have never let someone "sweat it out" for a few days like I have heard that some DXpeditioners will do. It is easy to say, "I am sorry old Buddy but I did not hear you". but I could never say this to fellows who are high up in the Honor Roll of DX awards. These fellows are the ones you work in the first few minutes or at most the first few hours if there is one of those tremendous piles you have if you set up in a really rare country. All you have to do is look at the first 50 call signs up high in the Honor Roll and you can be sure that these are the ones

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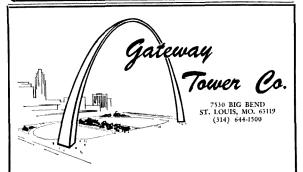
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The DXERS MAGAZINE c/o W4 BPD

Route I, Box 161-A, Cordova, S.C., U.S.A. you worked in very short order. These fellows didn't get where they are with sloppy or unethical operating habits. I suppose "back home" I was too much of a DXer at heart to pull any shady things. I wanted everyone to still be my friend after my DXpedition was over—just as they were before I ever departed. I think that this is exactly how it all worked out too. I tried to be cool and calm at all times and I think I was successful at it but at times it was very difficult to keep my temper under control.

But back to the story—at the meeting of the SARL it seemed as though I was back in the USA since things went about like they generally do here, with the exception of the South African brogue that they all spoke. Everyone was very interested in the forthcoming trip. I am sure most of them would have liked to be able to go with me. Of course, practically all of them wanted me to listen very closely for their call signs in the forthcoming pile-ups. Naturally, I promised each of them I would do just that! Later on I found that I could not miss hearing any of those ZS1's-their signals were the loudest that were heard at practically any hour of the day or night. I received a lot of invitations to come around and visit each of them and for the next day or two Jack and I did pay a number of visits to most of their QTH's. I can verify that those ZS fellows liked their coffee, usually on the strong side.

Capetown is a large, modern city with all the conveniences found in any modern-day city-large department stores and some super markets. Their prices were quite a bit higher than similar stores back in the States. Imported items from the USA were very costly, especially receivers and transmitters. seems their customs duties on radios and radio components carry a very high percentage. I was told that the stores did not cut prices on these items. Everyone around Capetown seemed prosperous, happy and well fed; fruit was very plentiful and reasonably priced. Meals at cafe's were not expensive at all and there were plenty of Cokes I am glad to say, but coffee was their favorite drink.

A few days before time for the boat to depart, Jack and I went down to the ship with all my radio gear (we had tested it out at his QTH before that day). We set it up in my little cabin and even erected the Hy-Gain 14AVS vertical ground plane with 2

ground radials for each band, from 10 through 40 meters. We went on the air and had a few QSO's signing ZS1OI/P. It worked right off the bat. I was all set for the forth-

coming ocean trip.

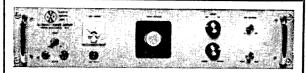
My friend Ed Coleman, K8TRW, had even shipped me two pair of red handles. I had tried them on and they fit as far as they went. They felt as though they would keep the Antarctic cold from getting to me. After leaving the ship we stopped at a fruit store and bought a good supply of fruit. In that big pile of fruit I think I even had a small bunch of bananas which weighed about 100 pounds! Then we stopped at a small super market and I got a big box of canned foods—I didn't want to go hungry while I was operating on some of the islands coming up later on. Oh yes, I got 100 gallons of gasoline (their gallons are about 25% larger than ours you know). This was to be delivered to the ship from the supplier. We both stressed the importance of it being delivered the next day, telling them the ship was departing that night-which was a white lie, but I didn't want to hold up the ship while they delivered it later on. It was a good thing we did this because the gasoline was not delivered the next day; it took another phone call to get it delivered the day before we actually did depart. I think the gasoline was Shell, but maybe I am wrong about this. Anyway, it was good gas and I had no trouble later on with the putt-putt starting, even in weather around 10°F. I did get 10 weight motor oil so it would not be too thick in the cold weather we knew was on the way.

After two more nights with ZSIOU and ZS1RM, Jack set the alarm clock for 5 AM on the morning I was going to depart. After a very good breakfast with them, Jack drove me down to the ship, saw me aboard, and even hung around until the PA system announced, "All ashore that's going ashore."

The ice breaker backed away from the docks, the bells rang, the whistle tooted a few times, and we were away for one of the most unusual trips I have ever been on.

Tristan da Cunha was to be our first stop to drop off three fellows who had lived there before the volcano eruption, a year or so before, had chased them away along with all the other inhabitants. We ate breakfast on board the ship and this was one morning that I had two breakfasts. More next month fellows, this was one trip I won't forget.

. W4BPD



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(continued from page 4)

The committee also presented a copy of a letter from a VU amateur claiming that the Laccadive expedition was not officially authorized. They further pointed out that Don's logs in an ARRL Sweepstakes contest and a DX contest contained some entries not confirmable in cross checking, implying to me that he was being accused of blatently cheating in these contests.

So, on the basis of the above accusations, they "suspended" credit for six countries Don had visited . . . plus any further countries that he might operate from in the future.

The uproar in the DX world was immediate and thousands of amateurs rushed to Don's aid. The League was forced to send out a letter on March 10th saying that Don hadn't really been convicted, just that they wanted the facts. Shades of McCarthy.

Don got word of the first letter on February 26th as he was about to land at Geyser Reef. He immediately turned around and returned to the States as quickly as he could and asked for a hearing at Newington with the awards committee. He found himself facing Bob Booth W3PS, the League counsel, flown up from Washington for the "case". After five hours Don gave up trying to be heard, cursing himself for having appeared without his own lawyer.

Don immediately set to work to document his defense and, at his own expense, published an 85 page answer to the ARRL claims, clarifying and presenting photocopies of pertinent letters. This effort undoubtedly cost him well over \$2000 by the time the book had been mailed to hundreds of overseas amateurs and societies.

The book is remarkable. It calmly takes each accusation made by the ARRL and refutes it completely. Where the League claimed that he sent QSL cards to donors without the benefit of on the air contacts, Don reprinted letter after letter from heavy supporters whose cards had been refused because of wrong dates or times. I gather that the League had just one chap who claimed to have received cards for non-contacts. Don comes up with many who did not get cards. It appears that Don even has witnesses to the fact that he did send reports to a station signing the call of his accuser.

Regarding the consulate activities he is supposed to have misrepresented, Don reprints a letter from the consulate accepting

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full responsibility and completely absolving Don.

Don has an answer on Navassa too. His letter from the Coast Guard would certainly put the lie to the claim of damaged amateur reputation. His published letter is from a legitimate Coast Guard rear admiral. Navassa is a strange situation anyway. There doesn't seem to be any real reason for not permitting a DXpedition to land there every few years . . . someone, probably in the State Department, made a decision sometime ago and we are forever after stuck with it. The bulk of the "damage done" seems to have been from ARRL demands for some official to either approve or disapprove of Don's visit. The coast guard attitude is one of we don't really approve, and sure wish you wouldn't do this again.

The VU letter about the Laccadives apparently was written by a chap in India who was hoping to be the first there and got beat out by Don. Don reprints letters which bear this out. And in reply to the nasty rumor that Don really wasn't there, I personally asked VS9MB in the Maldives just the other day about this and he says that the beam headings were absolutely right from him and that there is no question whatever in his mind that Don was actually there. Being just a few hundred miles away he should know.

Then there is the matter of the contest cheating. Don claims that the number of contacts that were unverifiable were small. well within the normal margin for error. It seems to me that this must be the true fact of the case since the League failed to do the obvious and point out that the "padding" would have materially affected the final score. If the bulk of the padding was new countries, this would be one thing . . . if it was just normal run of the mill contacts, that's something else. I have been amazed time after time to receive OSL cards for contest contacts where I had made a mistake in the calls . . . I had been so sure that I had gotten the call right!

Don, unable to get a fair hearing by the awards committee, asked that the board of directors review his case at the May 5th board meeting. John Huntoon sent a letter to all directors asking that they not review the case.

The basic concept here to me is that the ARRL is its thousands of members, not the few paid help at headquarters who are



At the Dayton Hamvention in Dayton, Ohio, the Long Island DX Association presented Don Miller, W9WNV, with a trophy for his outstanding contributions to DX for the year 1966-1967. Look for Don's new DX Column in future issues of 73.

running the show and that the HQ gang should reflect the wishes of the members, not always try to mold it. This is the basic concept that has been irritating me for a long time.

Apparently at least one of the ARRL directors agrees with me. One wrote to his fellow directors on April 10th asking, "Do you represent Newington in your division, or do you represent your division in Newington?" He further states, "I highly resent this super-inflated ego of a general manager to take over our elected responsibility."

The board, despite some frantic last minute moves by Mr. Huntoon, did hear Don out. The verdict, after presentation of all the evidence by Huntoon and Don, must have rekindled Don's faith in the ARRL, for he was upheld by the board on every count against him. They ordered Don's reinstatement in DXCC and affirmed credit for all of his DXpedition operations except K11MP/KC4 and VU2WNV.

Both of these exceptions seem to be more face-saving decisions that anything else. I gather on the VU2 deal that Don lost a critical telegram somewhere in his travels. The KC4 deal is a very bad one and we'll try to bring out the full background on this when we can name the government man responsible for the mess. ... Wayne

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Letters

April Issue

Dear 73.

Congrats on April 1967 cover design. Could have been me many years ago but for the soldering gun!

> Charles Hedrick W4WO Arlington, Virginia

Dear 73.

Have been reading your magazine since the first few issues, and with few exceptions, find your articles to be excellent. In your April issue the article on "The Super Duper Super" really carried me away. I can hardly wait for you to add the second audio stage so a loudspeaker can be used with it . . .

> John Mitchell K4MEM Miami, Florida

Dear 73.

I have received my third issue of 73, and am happy to say it is all that was promised—the articles are full of meat and not stuffy... In the April number I thought the Super Duper Super was really a gas that photo of the elderly Ultra-Audion (or whatever you'd call that circuit) with the neatly right-angled bus bar and '01A tubes was really authentic. Don't ask how I know. But about young Mr. Newham-won't Mad be mad about this?

> Alden Fowler WA9KHM Greensburg, Indiana

Dear 73,

. . . "The Super Duper Super"-Ugh!

Samuel Melbourne WB2INC Oakland, New Jersey

Dear 73.

. . . Considering the April issue, W4BRS's "A Toroidal VFO" contains some excellent ideas, but the article does not indicate a source of general toroidal information or a manufacturer which has a Tech-note or literature published that deals with toroids. By way of comparison and constructive criticism, W6GXN's "A Transistor Wien Bridge Oscillator" anticipated the demands of the more than casual reader. Also, may I state that I found W6FSM's "Ferromagnetic Beads" of value. Finally, K3SUK's stylistic lightness added much to the character of this issue.

> Carl Podlesny Jr. WA1AYP Amherst, Massachusetts.

Dear 73.

As I can readily see in the April edition, you are going in for fine technical articles, such as the Super Dooper. As luck would have it, I have a batch of UV201 tubes from 1924, a fine neutrodyne made in the same year, complete with basket-weave coils and a drip pan for the grid leak . . .

> Martin Hellman K2TAJ Staten Island, New York

Dear 73.

FB on the Super Duper Super-great. Hope to see more of this type.

> Jerry Cunningham, W1MMV Barre, Vermont

What are you going to use it for Jerry-WTW-200?

Dear 73.

The genius that is Al Freddy Newham's should never go unnoticed. The three pictures of him in the April issue was a kind gesture indeed on your part. After reading Mr. Newham's excellent report, we went right to work building this state-of-the-art goodie in our own rural paradise . . .

... We find the Super Duper Super to be an outstanding receiver in performance and it should compare favorably with factory-wired receivers costing 1/10 more. Maybe you have heard that a lab report on this fine receiver will be appearing in a future issue of Undeveloped Electronics (for advanced people) . . .

Mortimer Snerd WN6HCCE Orange Crate Road Napa Valley, California

Buried Antennas

Dear 73.

In reference to your April issue article on "Buried Antennas", after due consideration I have come to the conclusion that these antennas are for the birds. With the antenna buried in our back lawn, the earth worms would trip over the wire, giving the birds an early morning smorgasboard. Even when I fertilized the lawn to green it up, all my contacts claimed I had a lousy sounding signal. The experiment had to come to an end when the neighbors were kept awake at night by the mocking-gophers squeaking "CQ DX" in Morse code.

Jim Davis W6DTR Fullerton, California

Dear 73.

Although I am invariably in violent disagreement with Mr. Green's editorial comments, I am sold on the rest of 73. It's a pleasure to read an electronics magazine which doesn't fill its pages with exhaustively detailed plans for electronic coin flippers and the like. Keep up the good work.

John Gerhardt La Jolla, California

Dear 73,

"73 Circuits" was tremendous. Through 73 I have progressed from "connect to 34A (NS)" to where I am working out my own circuits. You've managed to keep me out of the pool halls for the past few years. Thanks again for a fine magazine.

John Rattinger WB2BRA Jackson Heights, New York

The Fabulous Drone

Dear 73:

My reason for writing you is because of the article you covered called, "Edison—The Fabulous Drone." It was alright except that it should have read, "Tesla—Greater Than Edison."

Maybe one of these days you will do a much bigger article on Tesla and the great work he did. Maybe when you find space you can list the address of a society that was formed after Tesla, The Tesla Society, Box 4058, Minneapolis, 14, Minnesota. Write for the "Tesla Bibliography" and other information—no charge for this.

Nick Basura Los Angeles 65, California

We can only print what we receive—anybody have a good article on Tesla?

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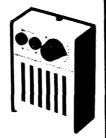
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The View From Here

(continued from page 2)

On the other hand, there are many facets of ham radio that are worthy of newspaper stories, magazine articles, and radio and television coverage. All we have to do is capitalize on them. Take a look at some of the things we've accomplished in the past few years that have received far less publicity than they deserved—Oscar, phone patches to Viet Nam, slow-scan television to Antarctica and moonbounce.

To interest new hams, we have to offer something besides radio contacts across town, to the next state or across the country. That's possible, albeit illegally, for far less effort on citizens' band. We have to offer enough incentive, enough excitement if you will, to kindle the soul of the new ham and sustain him through the code and theory.

There are plenty of things going on in ham radio today that should interest any science-minded youngster. Things he can get his teeth into and expend his energies upon. With the big interest in space exploration, the new amateur relay on the moon proposal—Moonray—is an excellent starter. Here is a chance to actually take a personal part in space exploration. Oscar is another approach.

Regardless of the project, to add new members to hamdom, it has to be publicized—well publicized. If you know a newspaper man, or a radio announcer, or a writer, encourage him to do some articles on amateur radio. It would only take a few articles in a couple of the big magazines to get a lot of response. And then, when a youngster expresses interest, help him along instead of offering indifference. A tour through your shack and a quick contact across the country is one of the best salesman we have.

Jim Fisk W1DTY

NEW BOOKS

RCA Silicon Power Circuits Manual

This new publication from RCA is the newest member of a growing family of RCA technical manuals. Although this manual is slanted toward the transistor design engineer. there is a lot of useful information for amateurs, students and electronic hobbyists. The chapter on high-frequency amplifiers is well worth the price of the book; more than 100 pages are devoted to this subject alone. In this chapter there are sections on designing rf power amplifiers, matching networks, mobile radio, SSB transmitters, UHF and microwave amplifiers and oscillators and frequency multipliers. In many cases design examples are given, with practical circuits both illustrated and analyzed.

In addition to the extensive chapter on rf power amplifiers, there are chapters on silicon rectifiers, thyristors, power conversion, power regulation, ac line-voltage controls and low-frequency power amplifiers. Copies may be obtained for \$2.00 from RCA distributors, or from Commercial Engineering, RCA Electronic Components and Devices, Harrison, New Jersey 07029.

Circuit Design for Audio, AM/FM and TV

This new book by the Engineering Staff of Texas Instruments is the fifth in a series of similar books on transistor circuit design and application. Originally published as a paperback, this new volume is an updated version detailing the most current design techniques and devices available.

Designed as a practical guide to audio, AM/FM and TV circuitry, the emphasis is on practicality. In addition to design examples, there are many practical *ready-made* circuits that should find wide use both in industry and amateur radio circles. The audio section of this handy book covers class A and B output and driver stage design with all types of coupling—transformer, RC and direct. Single-ended, push-pull and complementary stages design procedures are outlined with many practical examples.

In the AM/FM section there are chapters on if amplifier design, tuner design, and

applications. In the chapter on FM tuner design for example, there are discussions of noise performance, spurious response, AGC, and other topics of interest to the home constructor. The AM chapter covers the same subjects on a lower frequency scale.

The television section probably will be most interesting and informative to the VHF/UHF enthusiast. This section delves into VHF and UHF tuners, video and video if amplifiers, and sound if amplifiers—much of this information is directly applicable of amateur applications. In addition, the chapters on sync separators, vertical oscillator and sweep output, horizontal AFC, oscillator, driver and sweep output circuitry should appeal to the ATV man.

There is a lot of practical information in this book, and although it was designed primarily for the broadcast industry, almost all of the information may be applied to amateur circuitry by the serious experimenter. Except for a few rare cases, the math isn't beyond the high-school algebra class. \$14.50 from your local book store or write to McGraw-Hill Book Company, 330 West 42nd Street, New York, New York 10036.

Handbook of Electronic Instruments and Measurement Techniques

Here is a book that almost every ham should find useful in his shack. Harry Thomas and Carole Clarke, the authors, have prepared a complete reference on electronic instruments, measurements and techniques. The material has all been arranged in a manner so the data you want is easy to find. In addition to a complete rundown on all types of test equipment, the authors have included the latest methods and time-saving techniques used by industry.

In the first seven chapters they cover all the tools of the trade—meters, bridges, oscilloscopes, frequency, phase and time measuring instruments, voltmeters and instruments for testing tubes, transistors, receivers, transmitters and microwave equipment. In each case they describe the equipment with block diagrams, schematics and photographs.

The last seven chapters of the book dig into the intricacies of testing equipment and components. The chapters on receiver and transmitter testing should prove especially useful to the amateur. In the receiver sec-

SIDEBAND, UGH!

(IF YOU CAN'T FIGHT 'EM, WHY NOT JOIN 'EM?)

I am referring, of course, to the constantly heard complaint from the AM boys who argue about sideband. Now it is not my intention to argue as to which is best, "ancient modulation" or "silly sideband", as it is sometimes referred to. We all know that space in our spectrum is at a premium and that "Donald Duck" takes up less space and is inherently capable of greater gain and more reliable communication, but up in the relatively unsettled areas of our country, like the top of Maine or the center of Kansas, the AM boys can be heard sounding forth, and they do a surprisingly good job. I will concede this and I will not disagree when they way that SSB doesn't sound as good as AM.

Although there have been many advantageous sideband deals offered to the ham during the past 10 years, and I think I know my business well enough to write authoritatively, there has never been as sound a value as the offering I am making in this ad. Listen to this fellows: we will sell you a brand, spanking new Eico 753 kit (the latest one) with elaborately prepared instructions on building it yourself (it is really quite easy—it takes about 40 hours). This kit normally sells for \$189.95. We will sell you the Eico 753 3-band SSB-AM-CW transceiver with a Solid State silicon transistor VFO and our "meat and potatoes" power supply kit for the original selling price of the set alone, \$189.95 F.O.B. Harvard. You can not beat this value. You can compare every other price in the book and compare every other piece of equip-ment ever offered, and when you do you will understand that this is the lowest price for a 3-band sideband transceiver that has ever been offered. Consider its specs: The 753 will operate on 3490-4010 kc or 6990-7310 kc or 13890-14410 kc. On 40 and 80 meters it offers lower sideband, on 20 meters, upper sideband. You can inject carrier to obtain conventional AM. The set runs a PEP input of 250 watts with our "meat and potatoes" power supply kit, 180 watts with the Eico kit. The RF power output will be close to 150 watts when measured on a Waters watt meter. The output impedance matching range is 40-80 ohms. The sideband generation is accomplished by means of a 5.2 Mc crystal lattice filter with a bandwidth of 2.7 kc at 6 db. The stability is amazingly good, being less than 400 cycles after a 15 minute warm-up. Unwanted carrier is down 50 db, unwanted sideband down 40db. This set uses incremental tuning plus or minus 5 kc so that as you tune slightly for the other fellow you will not change your own transmitting frequency. The tune-up is conventional; the audio input provides for high impedance microphones. The receiver sensitivity is one microvolt for 10db signal-to-noise ratio. The over-all dimensions are 5½" high, 14" wide and 11¼" deep. The price on this interesting kit is so low that some people can afford to buy 2 units, one for the home and one for the car. We offer the Eico DC supply for \$59.95 as a kit, the original matching Eico AC supply for \$59.95 as a kit, or the Eico 753 kit at \$149.95 by itself. The best value, of course, is the original quotation of \$189.95 for both our "meat and potatoes" power supply and the Eico kit. You can find out more about the "meat and potatoes" power supply kit in our previous advertisements in 73 Magazine. It is a heavy bruiser of a supply which will positively meet the requirements of this transceiver and most other transceivers as well. We offer terms to those deserving of them and prompt shipment from stock on this extremely good value. You can work the world on 20, you can have lots of fun on 80 and 40, remember that you can operate CW or AM if you choose, but this is essentially a sideband rig and on-the-air reports compare favorably with the most expensive transceivers. The unit includes high level dynamic ALC circuitry so that you won't flat top even with extreme over-modulation. Boys, if you want to get into sideband, there is no easier way. You will have lots of fun building this kit. I guarantee the results personally, so why not consider this very inexpensive means of going on 3 bands.

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Woodchuck Hill, Harvard, Mass. 01451 Telephone 617-456-3548 tion for instance there are discussions of sensitivity measurements, selectivity measurements, image rejection, backlash, overload, frequency stability, noise measurements, and audio fidelity and distortion.

The 54-page appendix covers those measurements and instruments that don't fit into the context of the other chapters, as well as several mathematical tables. All in all, this is a very useful handbook for the amateur who wants to know how to better use his test equipment. \$16.00 at your local bookstore or write to the publisher, Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632.

Servicing TV Receiver Circuits

If you're like most hams, you've probably been called on at one time or another to fix the family television set. And-if you're like most, if the trouble isn't the fault of a bad tube (or transistor) or burned out component, off it goes to the service shop. This new volume by the editors of Electronic Technician should solve all that. In addition to describing each section of the home television set in detail, circuit analysis and trouble-shooting techniques are outlined along with voltages and waveforms at the various stages. Transistor sets are described too, as well as a big section on color. This new book should be of special interest to the ATV group and ham handyman. Liberally illustrated with schematics and photographs. \$6.95 from your local bookstore, or write to TAB Books, Drawer D, 1 Frederick Road. Thurmont, Maryland 21788.

Transistors: Principles and Applications

In this new book R. G. Hibberd, the author, presents a wealth of information on transistor circuits in a way that should appeal to many. His approach is almost completely free of math, and emphasis is placed on strictly practical considerations. The book starts off with a little semiconductor history and their physical properties, but quickly gets into dc operating conditions and bias circuits, low-level and high-power audio amplifiers, oscillators, receivers, switches, power supplies, solid-state techniques and use and handling of transistors.

In addition to the chapters on transistor circuits, there is information on integrated circuits, metal-oxide transistors, semiconductor lasers and FET's. For the ham who wants to know more about transistors, here is an

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Antennen Praxis

If you can read German, and want a complete handbook on practical antenna design, this new book by Gunther Rothe and Eberhard Spindler is worth looking into. Propagation is thoroughly covered, along with antenna measurements and theory. All types of antennas are covered, including dipoles, verticals of various heights, Yagis, parabolas, log periodics, and multi-frequency units. In many cases practical antennas are outlined, complete with gain figures and vertical and horizontal pattern plots. For the antenna man who can't read German this text can still be very useful. It is liberally sprinkled with math—and that is universal throughout the world. For more information, write to VEB Verlag Technik, Berlin, Germany.

Troubleshooting with the Oscilloscope

If you haven't already found out that the oscilloscope is almost indispensable in the workshop, you probably will soon. Most authorities feel that in the future it will be extremely difficult to service modern circuitry without the extensive use of an oscilloscope. In his new book Robert Middleton provides a complete breakdown on the operation and use of this versatile instrument. If you read this book, you will have a pretty complete working knowledge of the oscilloscope, even if you haven't used one before.

He first shows you how to operate the instrument and how to pick the proper probes for various tests and measurements. Then you learn what types of test signals are required, the types of waveforms to expect and how to properly interpret them. The sections on trouble shooting include receivers, if amplifiers, audio amplifiers, solid-state devices, television and stereo multiplex equipment. This book tells how to isolate defective stages or sections by waveform analysis, and includes numerous pictures of typical waveforms associated with various defective components. If you want to learn how to use a 'scope or to put your instrument to better use, this is the book for you. \$3.95 from your electronics distributor, or write to Howard W. Sams & Company, Inc., 4300 West 62nd Street, Indianapolis, Indiana 46206.



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WANT to borrow manual for Hallicrafter S-27 receiver so I can make photocopy. Will purchase manual if you want to sell. W1DTY, RFD 1, Box 138, Rindge, N.H. 03461.

CAPE KENNEDY HAMFEST, sponsored by Platinum Coast Amateur Radio Society. Second annual hamfest, at the civic auditorium, Melbourne, Florida, August 26 and 27. Home-making and flower shows. Swap tables and equipment auction the hit of the 1966 hamfest. Give-away every hour, and of course BIG, BIG door prizes. Fun for the XYL, the kiddies and the OM himself. For information write Box 1004, Melbourne, Florida.

GROUNDED GRID FILAMENT CHOKES. 10 amp \$3.00; 22 amp \$3.50; 30 amp \$4.00. RF plate chokes 800 ma, \$1.95. PP USA48. Deane Co., 8831 Sovereign, San Diego, Calif. 92123.

COLLINS 75A-2, \$190; Immaculate T-105A, \$65. Want HW-32 or 10, 15 meter SSB homebrew transceiver, working or? WA7DXQ, Box 7668, Phoenix, Arizona.

GALAXY V AC & mobile supplies, speaker console, microphone, Hustler, 2 resonators. \$425 or best reasonable offer. Paul Gough, 18 Eliot Ave., West Newton, Mass. 02165, 617-527-6599.

6288 FEET HIGH for 6 & 2 DX on Mt. Washington, N.H. Take your gear up on the Cog RR from Base Station. Food and facilities available at Summit House, aso bunks for overnight.

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PANHANDLE AMATEUR RADIO CLUB annual hamfest, June 24 and 25, at National Guard Armory on T Anchor Blvd. off Route 40, Amarillo, Texas. For more info., write Box 5453, Amarillo.

FINGER STOCK, silver plated, 3/8" x 16", six pieces \$2.00 PP. Carl Thompson, 6250 Thole Rd., Cincinnati, Ohio, 45230.

SB-100, HP-23 AC supply, perfect condition, never mobiled, will deliver near Chicago. \$375 or best offer. W9JDX, RR1, Box 510, Cary, Illinois, 312-639-7565.

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SOUTHWESTERN/PACIFIC DIVISIONS ARRL CONVENTION September 8-10, Ambassador Hotel, Los Angeles. Registration \$2 (with banquet \$10) until Aug. 15; thereafter \$3 and \$12. Checks to "ARRL Convention", and send to Box 3151, Van Nuys, Calif. 91405.

PACKAGE: SB-400 and SB-300 with CW filter. Perfect. First cashier's check for \$525, best offer over \$500, brings postpaid shipment. WB4BUQ, Marshall P. Williams, 1610-B, Fort Belvoir, Virginia.

THE LONG ISLAND HAMFEST will be held at Hempstead Town Park, Point Lookout, Long Island, N.Y., on Sunday, July 16th beginning at 9:00 A.M. Bring your family and enjoy the fun. For further information write Federation of L. I. Radio Clubs, Box 304, Long Beach, N.Y.

MAKE OFFER: Amateur telephone transmitter for 10, 20, 40 & 80 meters. Send postage for details. W6LNE, 1159 Loma Sola Ave., Upland, California 91786.

VIKING 500 transmitter complete with power supply, modulator. Excellent condition. Originally sold for \$949.50. Will sacrifice for \$275 or best offer. Also sell AC and AD coils for National HRO-60, best offer. Michael Sposato, K1NEK, 4 Northboro St., Worcester, Mass. 01604.

SWAP—NEED ROTATOR, VTVM: All parts for high power class B modulator, pr 805, 2A3 drivers with schematic. PS 1250 @ 300 with pr 866. Plate transformer 2500 @ 300/2000 @ 500 mils. Prefer local deal up to 75 mi. WA1BLY, 9 Lowlands Ave., Easthampton, Mass., Tel. 413-527-2344.

DX-60A. Superb condition. A steal at \$55.00. Will ship reasonable distance. Richard Gelber, WB2WOI, 350 First Ave., New York, N.Y. 10010.

HY-GAIN 18-AVQ, brand new in original box. Going for full size 80-meter vertical. Delivered prepaid, \$39.50. WØRA/1, Box 115, Greenfield, N.H. 03047.

WANTED: Copies of VHFER magazine, years 1963 and 1964 for personal collection. W1DTY, RFD 1, Box 138, Rindge, N.H. 03461.

HEATH DX-20 WANTED. SSB mobile xmtr. Cash or? L. K. Flaherty, P.O. Box 3772, Anaheim, Calif., Phone 714-635-0150, Ext. 505.

TV CAMERA & MODULATOR: Packard Bell model 920, \$315.00 incl. shipping in USA. R. Hage, 337 Glenwood Av., Ventura, Calif. 93003, 805-642-5329.

WANTED: Collins VFO unit for R390 receiver. Have defective unit for exchange or cash. Sell or trade lab gear Gen radio H.P. BC-221 Tektronix Bird TEDs 1 to 9. List? Sides Radio, 542 N. First St., Albemarle, N.C.

INTERNATIONAL FIELD DAY 9 A.M., August 13th, at Cliffside Country Club, Burlington, Vermont, sponsored by Burlington Amateur Radio Club, Inc. Busy day for OM, XYL and JRs. Contests, Bingo, Chicken barbeque at noon, Special Trio for the teenagers. Swap-shop and auction, Net meetings, Swimming, Boating, Eye-ball QSO's. Talk-in freqs. 3909 SSB, 3855 AM, 146.94 Eye-ball FM-146.34 FM (Rep.). Door prizes, Raffles. \$3.00 at the gate, \$2.50. Early Bird registration. Send early registrations to W10KH, Lloyd Tucker, Box 16, Essex Center, Vt.

NEW UNUSED: Henry 2KD-2 linear complete, \$595.00; Swan 500, \$380.00; Heath SB-200, \$190.00. Never been opened, factory sealed, warranty cards. Don Payne, W4HKQ, Box 525, Springfield, Tenn. 37172.

DUMMY LOAD, 50 ohms, flat 80 thru 2 meters, coax connector, power to 1 KW, kit \$7.95, wired \$11.95 PP. Ham Kits, Box 175, Cranford, N.J.

WANT: R278/GR or R278B/GR; also R391 receivers Thompson, 5 Palmer, Gorham, N.H.

WANTED: Tubes, transistors, lab instruments, test equipment, panel meters, military and commercial communication equipment and parts. Bernard Goldstein, Box 257 Canal Sta., New York,

TOOOOBES: 811A—4.25; 7094—26.90; 6146A—\$2.55; 6CW4—\$1.40; 5894—\$15.50; Extra power 6146B—\$4.00; 6360—\$3.45; 8236—\$9.50. All new, boxed, guaranteed. Free catalog. Vanbar Distributors, Box 444Y, Stirling, N.J. 07980.

SELECTRONIX AUDIO FILTER, use between receiver and speaker or phones, cuts monkey chatter and narrows band pass to about 1000 Hz. Some QSO's possible only with this in circuit. \$24.95 pp. WØRA/1, Box 115, Greenfield, N.H.

WANTED: Instruction manual for the Hallicrafters S-27 UHF receiver or copy. I will make copies if there is a manual available for loan. W1DTY, RFD 1, Box 138, Rindge, N.H. 03461.

PIPE SMOKERS: Three $1\frac{1}{2}$ oz. sample pouches of the world's finest pipe tobaccos. \$1.50 plus 50¢ handling charges. Smoke Rise, W4ANL, 13118 Thompson Rd., Fairfax, Virginia 22030.

LOUISVILLE HAM KENVENTION: September 8-9 1967. Beautiful Executive Inn Motor Hotel, Waterson Expressway at State Fair Grounds, Louisville, Kentucky. Participate in the technical sessions, forums, prizes, banquet and flea market. Bring XYL for day of women's activities. For information write Louisville Ham Kenvention, Box 20094, Louisville, Kentucky, 40220.

"SAROC" Sahara Amateur Radio Operators Convention 4-7 January, third annual fun convention hosted by the Southern Nevada Amateur Radio Club. Designed for exhibitors and participants at Hotel Sahara, Las Vegas, Nevada. MARS seminar, Army, Airforce and Navy representatives. Ladies luncheon with crazy hat contest, hat should convey amateur radio theme. Plus fabulous entertainment only "Las Vegas" can present. Registration fee includes three cocktail parties, Hotel Sahara show, hunt breakfast, technical sessions, admission to leading manufacturers and sales exhibits. Advance registration closes one January. QSP QSL with ZIP and telephone number for details to Southern Nevada Amateur Radio Club, Box 73, Boulder City, Nevada 89005



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ST. LOUIS COUNTY, MISSOURI: Second annual hamfest of the Suburban Radio Club. Sunday, July 30th, 1967, at Creve Coeur Lake Memorial Park, St. Louis County. For further information write Joe Owings, KØAHD, Suburban Radio Club, 10217 St. Daniel Lane, St. Ann. Mo. 63074.

SIX METER CLUB OF CHICAGO, Tenth annual picnic and mobile meet, Sunday, August 6th, at Picnic Grove. on Route 45 one mile north of Route 30, Frankfort, Illinois. For further information write Alfred Bagdon, K9YJQ, Chairman, 7804 W. 66th Place, Bedford Park (Argo P.O.), Illinois 60501.

INTERNATIONAL CHC/FHC CONVENTION: Third annual convention, at Stouffer's Inn, 120 W. Broadway, Louisville, Ky., August 3, 4 and 5, 1967. For further information write Fred Gleeson, WA4LMD, Box 20114, Louisville, Ky. 40220.

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controlled ava a controlled avalancho rectifier in which the PRV may be exceeded without destroying the rectifier.

0113	reci	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	٥١.
	PRV	,	
	100	I	.12
	200	1	.15
-	400	1	.20
	60 0	1	.25
	80 0	1	.35
- 10	000	1	.50

Top E	Hat poxy	&
PRV	1	AMP

L D A	1	A IN L
100	1	.07
200	1	.09
400	1	.12
600	Ī	.20
800	1	.25
1000	T,	.50
1200	1	.65
1400	1	.85
1600	1	1.00
1800	T	1.20



Silicon Control Rectifiers TO-66

PRV	3A	7A	20A
50	.35	.50	.80
100	.50	.70	1.35
200	.75	1.05	1.90
300	1.25	1.60	2.45
400	1.50	2.10	2.85
500	1.75	2.80	3.50
600	2.00	3.00	
700	2.25	3.50	
1000		5.00	

	S	ilicon		Power		Roctifi	ers	
PRV	1	3 A	1	20A	1	40A	1	240A
100	1	.10	Ī	.40	1	1.00	ı	5.00
200	1	.20	1	.60	1	1.50	1	7.00
400	1	.25	1	.80	1	2.00	1	12.00
600	1	.35	1	1.20	1	2.50	T	20.00
800	1	.45	1	1.50	1	3.00	1	
1000	T	.65	1		Ī	3.50	1	35.00

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Propagation Chart

JULY 1967 **ISSUED MAY 15**

J. H. Nelson

EASTERN UNITED STATES TO:

GMT	60	02	64	66	0s	10	12	14	16	18	20	22
ALASKA	14	14	14	74	7	7	7	7A	14	14	34	14
ARGENTINA	21	21	14	14	74	7	14	14	21	21	21	21
AUSTRALIA	14	14	14	14	78	7	7	7A	74	7B	14	24
CANAL ZONE	21	14	14	14	14	7	14	14	14	14	21	21
ENGLAND	14	14	74	74	7	14	14	14	14	14	14 4	14/
HAWAII	144	144	14	14	7	7	74	14	14	14	14	14
INDIA	14	14	14	78	7B	7B	14	14	14	14	14	14
JAPAN	14	14	14	7B	710	7B	7B	14	14	14	14	14
MEXICO	144	14	14	14	7	7	14	14	14	14	14 A	14
PHILIPPINES	14	14	14	74	7B	7B	74	14	14	14	14	14
PUERTO RICO	144	14	14	7 A	7	7	14	14	14	-14	14	14
SOUTH AFRICA	78	7B	7B	14	14	14	14	14A	21	21	14	14
U. S. S. R.	14	14	14	14	74	14	14	14	14	14	14	14
WEST COAST	164	144	14	14	7	7	74	14	14	14	14	14

CENTRAL UNITED STATES TO:

ALASKA	14	14	14	14	7A	7_	7	74	14	14	14	14
ARGENTINA	21	21	14	14	74	7	14	14	21	21	21	21
AUSTRALIA	14	14	14	14	14	14	7	7A	74	78	14	14
CANAL ZONE	21	14	14	14	14	74	14	14	14	14	21	21
ENGLAND	14	14	7A	7.4	7	7	14	14	14	14	14	14 4
HAWAII	144	14A	14	14	14	14	74	14	14	14	14	14 A
INDIA	14	14	14	14	78	78	7B	14	14	14	14	14
JAPAN	14	14	14	14	78	78	78	14	14	14	14	14
MEXICO	14	14	14	74	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	74	78	7B	74	14	14	14	14
PUERTO RICO	21	14	14	14	7	7	14	14	14	14	14 A	144
SOUTH AFRICA	тв	7B	78	74	78	14	14	14	14	14	14	14
g. s. s. H.	14	14	14	14	7	7	14	14	14	14	14	14

WESTERN UNITED STATES TO:

ALASKA	14	14	14	14	74	7	7	7	14	14	14	14
ARGENTINA	21	21	14	14	74	·	14	14	21	21	214	21
AUSTRALIA	21	21	214	21	14	14	14	7A	7A	78	14	21
CANAL ZONE	21	14	14	14	14	7	14	14	14	14	21	21
ÉNGLAND	14	14	7A	74	7	7	7	14	14	14	14	14
HAWAIT	21	21	21 4	21	14	14	14	14	14	14	14	21
INDIA	14	14	14	14	14	7B	78	7 A	14	14	14	14
JAPÁN	14	14	14	14	14	14	7B	74	14	14	14	14
MEXICO	144	144	14	14	14	7	7	1,4	14	14	144	144
PHILIPPINES	14	14	14	14	14	14	78	74	14	14	14	14
PUERTO RICO	144	14.8	14	14	74	7	74	14	14	14	14	14
SOUTH AFRICA	TB	тв	7B	74	7B	713	14	14	14	14	14	14
U. S. S. R.	14	14	14	14	7	7B	733	14	14	14	14	14
EAST COAST	144	144	14	14	7	7	74	14	14	14	И	и

- A. Next higher frequency may be useful this hour.
- B. Very difficult circuit this hour.

Mica Condsr .006@2500 Snooperscope Tube 2" \$ Minni-Fan 6 or !2Vac/6 4X!50 Ceramic Lokta! \$! Line Filter 200Amp/130V DC 3½" Meter/RD/800! DC 2½" Meter/RD/30V! DC 4" Meter/RD/IM	V
Socket Ceramic 1625 Tub Socket Ceramic 4X150/L Wanted 304TL - Toj 2.5M H PiWound 500Ma Knob Spin-Crank BC348 MiniFan 6 or 12 VAC 3 Beam Indicator Selsyns Precision TL147 Feeler	oktal4/\$2 o \$\$ <i>Paid 1</i> Choke3 for \$1 i \$1@,3 for \$2 kl 50@4 for \$5
Fuse 250 Ma/3AG XMTTG Mica Condsr .00 W.E. Polar Relay #255/ W.E. Socket for #255A Toroids 88 Mhy New Pck 6.3VCT @ 15.5A & 6.3VC 200 KC Freq Std Xtals \$ Printed Ckt Bd New Blan	6@ 2.5Kv2/\$
Klixon 5A Reset Ckt Bres Line Filter 4.5A@115V Line Filter 5A/@125V/A 866A Xfmr 2.5V/10A/I(Choke 4HY/0.5A/27Ω\$3(Stevens Precision Choppe Helipots Multi Ten-Turr Helipot Dials \$4@	rs \$2@3/\$5 1@\$5
2500V@10Ma & Fil \$2@ 1100VCT @ 300Ma, 6V 8 125V Bias abt 1200VDC: 2.5V@2A \$1@ 6.3V @ IA \$1.50@, "Bruning" 6" Parallel R PL259A & 50239 CO-AX Phone Patch Xfmrs Assi	\$5@4/\$15 3 for \$2 4 for \$5 tule @,\$1 M&F Prs3/2\$
Insitd Binding Posts Sun-Cells Selenium Assto .01 Mica 600WV Conds .001 to .006 Mica/1200W	16/ \$ 1

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.05	.07	.10	.12
400/280	600/420	800/560	900/630
.14	.21	.30	.40
1000/700	1100/770	1700/1200	2400/1680
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w				
D. C.	50PIV	100Piv	200Plv	300Piv
Amps	35Rms	70Rms	140Rms	210Rms
3	.10	.15	.22	.33
12	.25	.50	.75	.90
18	.20	.30	.75	1.00
45	.80	1.20	1.40	1.90
160	1.60	2.90	3.50	4.60
240	3.75	4.75	7.75	10.45
D. C.	400PIV	600Piv	700PIv	900Piv
Amps	280Rms	420Rms	490Rms	630 Rms
3	.40	.50	.60	.85
12	1.20	1.50	1.75	2.50
18	1.50	Query	Query	Query
45	2.25	2.70	3,15	4.00
160	5.75	5.75	Query	Query
240	14.40	19.80	23.40	Query
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541/3, 985/7
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100 Q Q 500 2.50 3.75
200 0 0 600 3.25 4.25
300 1.80 2.25 700 4.00 500
400 2.00 2.00 800 4.75 5.65
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Glass Dindes I N34 48 60 64 20 for \$1
G1235 D10005 11107, 40, 00, 0420 10[\$]
2 RCA 2N408 & 2/1N2326 Ckt Bds
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DISCAP .002 Mfd@6KV 6 for \$1
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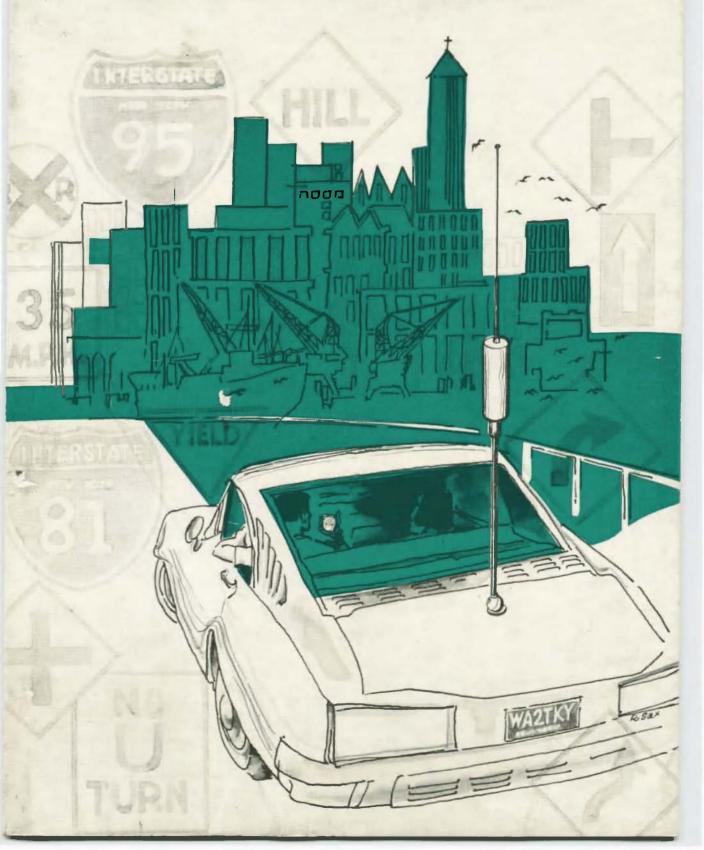
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AMATEUR RADIO



73 Magazine

August 1967

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4. 4



With the slackening growth of ham radio, a number of proposals have been made, and perhaps the most interesting and promising of these is an idea I first heard from Bob Waters, W1PRI. He, and some of the other ham manufacturers, are advocating several modifications to the current Novice regulations which they think would attract more youngsters to our hobby.

Although a great number of Novices go on to the General and higher class licenses, many sell their gear after their twelve months is up and try another hobby. The manufacturers feel that if the period of the license was extended to two years, if a small Novice phone segment on ten meters was available, and, if the name of the Novice class was changed, we would see an increase in Novice licensees, and subsequently, higher-class licenses.

The current twelve-month limitation on Novices is a serious problem to many young hams. Many of them are high-school students, and in addition to their chosen hobby, they have homework, sports, probably a parttime job and all kinds of other activities to take up their time. With only so many hours in the week, there's just not much time left to devote to ham radio. The fact that many of them are able to upgrade themselves to the General license in the limited time available

is a credit to their ability. I wonder how many adults would be able to do as well under the same circumstances?

If the license period were extended to two years or even longer, a great many more Novices would be able to qualify for a higher class license. There doesn't appear to be any good reason why the Novice license should not be issued for a two- or five-year period. Some Novices graduate to the General class in a year, but how many more would make it if they had more time?

In addition, limited phone privileges on ten meters would serve to introduce the Novice to the *true* picture of ham radio. The two-meter allocation they presently enjoy does this in some part of the country, but, in many areas there is almost no activity on 144 MHz. Up here in New Hampshire, for example, except on VHF Contest weekends, two-meter activity is nil. With a low-noise converter and a high-gain antenna, I hear a few DX stations, but with the equipment the average Novice is apt to have, he wouldn't hear anything except noise! I'm sure the same thing is true in other parts of the country too.

If you have a receiver that covers the top 1 MHz of the ten-meter band, you'll find it to be a veritable wasteland. In some areas there are a few FM repeaters and channelized CB-style stations, but the unused spectrum between them is going to waste. And of the upper 1 MHz, who is operating on the top 200 kHz? Thus far I haven't heard a signal up there.

Even the best of the five-band transceivers does not cover the entire 28 MHz band. Most of them provide one 500 kHz segment, while a few give a full 1000 kHz, usually 28 to 29 MHz. Unless you have a general coverage receiver, or have gone to the trouble to buy an extra crystal, chances are you have never even listened above 29.0 MHz. I have, and I can tell you, except for sporadic activity on a few net frequencies, the band is empty even when the skip is in.

The allocation of 29.5 to 29.7 MHz phone privileges to the Novice would give him a chance to get his feet wet and see what amateur radio is really like. If you had to operate CW in the congested Novice portions of our lower-frequency bands when you started out, I wonder how many of you would still be licensed and active?

The manufacturers would also like to change the name of the Novice license to

(Turn to page 103)

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never say die

After the big party of EP hams the night before, I felt sorry for Gerry EP2GF as we headed for the airport at 4:00 in the morning with very little sleep under our belts. What a ridiculous time of the morning to fly. The plane actually got off about 6 and, after four hours of flying across desert and treeless mountains, we dropped into Kabul.

I'd worked one YA from home before the trip, but didn't get more than a signal report through all the QRM, so I didn't have much of an idea what was waiting for me. I'd talked briefly to Ed YA1DAN from EP2GF and knew that he would be meeting me at the airport and would put me up during my two day stay.

Sure enough, there was Ed, waving to me from the gallery as we landed, QSL card in hand for identification. He came down and put in a good word with the airport manager and I was rushed through the formalities of customs and immigration and on my way to town. After a stop to say hello to YA1FV and some of the other fellows, we went on to Ed's house, which turned out to be a veritable palace.

Ed, a maintenance man with the FAA in Kabul, lives with his family in a house that would run easily \$100,000 over here, complete with two servants to keep the place clean, cook the meals, serve and keep the clothes washed and ironed, a not unsubstantial job for a family with four small boys. Things are not expensive in Afghanistan, obviously.

Ed drove me to downtown Kabul and we walked through the small stalls that serve for stores there. Ed haggled with dealers here and there for old Afghan coins to add to his collection, which is probably already one of the finest in the world. He explained that the ice for the cold-drink stands around town was brought down from the 17,000 foot high mountains just out of town which have snow on them all year around. Kabul is at about 7000 feet altitude. We watched them bake bread by sticking the flat loaves to the side of the ovens for a minute or so and then prying it off with long sticks working through the fire in the middle of the oven.

Ed explained that the white community has to be ever on the watch against sickness. I watched the Afghans bathe in the

A Push-Pull Class B-Linear

A I kW push-pull grounded-grid linear amplifier using 3-400Z's.

It is one of those minor ironies that during the past ten or fifteen years, while the singleended audio amplifier has almost completely given way to push-pull, exactly the reverse has occurred in respect to rf amplifiers. This is even more surprising when one remarks that rf amplifiers nowadays are seldom called upon to perform a modulating function and so are, like their audio counterparts, devices for raising the power level.

The faculty of even harmonic distortion cancellation attributed to push-pull circuits depends upon tight coupling between the two halves of the output circuit—this is very much more easily realized at audio than at radio frequencies. Nevertheless, there is a basic symmetry in the push-pull circuit that can hardly do anything but help to produce a symmetrical output which in turn is likely to possess fewer spurious components.

The case for the grounded-grid amplifier has been competently and extensively made and does not need elaboration here. It seems then that a push-pull grounded-grid amplifier would be an especially attractive proposition. Before launching into a description of one such amplifier, I should like to identify some of the other assumptions (perhaps they should be called prejudices) that underlay the project:

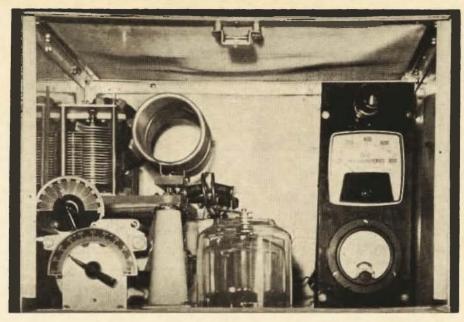
1. Bandswitching is not necessary or even desirable if it must be bought at

the price of tapped coils or huge voltages across unused coil segments.

- 2. The desired frequency range is 3.5-29.7 MHz, CW and SSB, and power input capability up to the legal limit. Both plate voltage and current must be continuously monitored at such power levels to satisfy Canadian government regulations.
- 3. Shunt feed is only acceptable as a last resort.
- 4. Voltage-doubling circuits, choke-less filters, series-string rectifiers and filter capacitors and such artful dodges are to be avoided.
- 5. The driver is a B & W 6100 and the load will be a 50 ohm (nominal) unbalanced antenna.

Fig. 1 is the schematic of the completed amplifier. To sum it up, it consists of two Eimac 3-400Z zero bias triodes with 3000 volts on the plate in a push-pull grounded-grid connection. RF drive is series fed to the cathodes (heated by two separate filament transformers—872 type filament transformers have sufficiently low capacitance for this application) from a transformer whose primary is connected to a pi network of reactances affording impedance matching to the driver

The interior of the pushpull grounded-grid amplifier. The 3-400Z's are located in the center, the plate current and voltage meters to the right and the output circuitry to the left. The toroidal rf power transformer is hidden by the vertically mounted variable capacitor to the left.



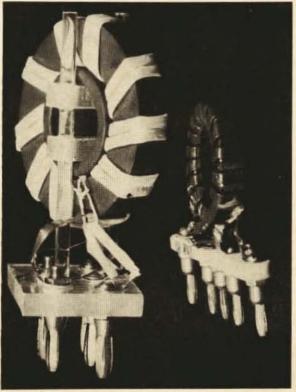
output. The output circuit is series fed with a split tank coil. The loading of the stage is controlled by the variable capacitor across the output transformer primary. The power supply (full wave 872's; single section L/C filter; 24 µF total capacitance) is of standard design. As for housing the linear, quite conventional construction practices were employed—the underside of the chassis is kept air tight so that a single fan (Ripley SK-4125) can handle both tubes which are mounted in Eimac air system sockets and chimneys.

The rf transformers

The central features of this linear are the trifilar input and output transformers pictured in Fig. 2 and detailed in Fig. 3. "Trifilar" means that three conductors are grouped and wound onto the core as a single turn. Ferrite core material is employed because of its admirable magnetic properties at radio frequencies. This mode of winding on this type of core seems to produce the tightest possible coupling consistent with low losses and reasonable distributed capacitance. In both cases the transformers are used with two windings connected in series and one winding by itself. The input transformer is, therefore, 1:2 step up in turns. However, since only one tube is operating at any one instant, it may be viewed as simply 1:1 in terms of impedance. The output transformer has part of the tank circuit circulating current in its primary and sees the antenna as its load, so it is 2:1 step down in turns and 4:1 step down in impedance. The transformers provide good performance on three adjacent ham bands so there is an overlap on 14 MHz.

The pi input network

In spite of the additional coil which requires band switching, this network more than pays its way for several reasons. First,



The trifilar wound of transformers. Ferrite cores were used in the interest of close coupling, low capacity and high Q.

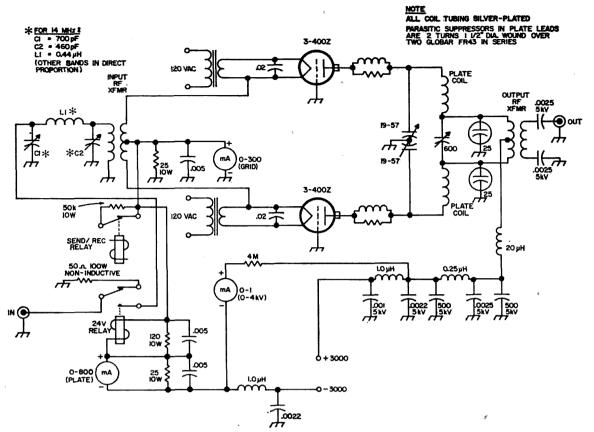


Fig. 1. Schematic of the push-pull grounded-grid class-B linear amplifier. The dual 19-57 pF capacitor in the plate circuit was made from a surplus unit, 0.25 spacing, by removing all but four stator plates per section.

it serves as a reservoir of stored energy whose flywheel action serves both to couple the tubes together and to stabilize their waveform. Secondly, it provides almost complete isolation betwen the linear and its driver, thus making it possible to make the SWR presented to the driver very close to 1:1.

Since the definitive article on *all* phases of grounded-grid power amplifier operation apparently has yet to be written, it is, perhaps, appropriate to summarize the problem of driving such an amplifier. Four impedances are of concern:

- 1. The impedance looking toward the amplifier—analytically, this represents the fed-through power plus the grid losses.
- 2. The impedance seen by the cathodes of the linear stage looking back toward the driver. Theoretically this may be zero—practically it must be finite. Furthermore, if there is to be any stored energy, reactances must be involved and resonance must be achieved so that the cathode-ground voltage will be in phase with the plate current.

- 3. The desired impedance seen looking forward from the exciter. This is almost always 50-52 ohms (unbalanced).
- 4. The impedance seen looking back into the exciter output terminals. This may be nearly any small resistance, often accompanied by a larger reactive component.

Suppose that, on the basis of reasonable capacitor sizes and modest Q, we aim to make the cathode to ground impedance (2) equal to the impedance looking toward the amplifier (1). Since impedance is equal to O times capacitive reactance $(Z = Q X_c)$, high Q's call for low X₆'s and therefore, large capacitors. The basis of this design was Q = 5; therefore, the capacitive reactance (X_c) is about 25 ohms since (1) is approximately 125 ohms for the 3-400Z in this circuit. A nameless but very useful theorem* states that in any circuit containing loss-less elements (L, C, and perfect transformers), if a conjugate impedance match occurs at one junction then it must exist at every other junction and conversely. Such a state of affairs would mean that the conjugate of (4) would

be the load to the driver and this is nowhere near the value of (3). To be blunt, there would be a very high SWR on the driverto-linear transmission line with consequent difficulty in getting power out of the driver. As an additional complication, unless the exciter and linear are bolted together, these various impedances are transformed differently depending on whether one is considering the direction — exciter to linear or linear to exciter. Not only that, these transformations will be different on different bands unless the length of coaxial line is changed when changing bands. The only straightforward way out of this dilemma is to swamp out the impedance irregularities by imposing the greatest power loss that can be tolerated between the exciter and the linear. Consequently a 3 dB pad (see Fig. 4) is placed between the linear and the exciter. Since the greater the loss in the pad the greater isolation it affords, and since there is a considerable surplus of drive from the B & W 6100, the pad could have been raised to 4 dB or so in my case to some advantage.

Drive interlock

Most articles on grounded-grid amplifiers view the possibility of drive being present with no plate current with alarm—an eventuality that has been rendered almost impossible by the drive interlock relay whose resistor terminates the driver when the relay is not actuated.

Trials and tribulations

Perhaps a paragraph or so on the unsuccessful experiments and assorted disappointments would be appropriate here. The feasibility of the cathode drive transformer idea was established at the outset in a series of experiments involving 809's and 811's (not 811A's). Cross neutralization of these tubes is easily achieved by bringing a lead up through the chassis from a cathode to a copper bracket and facing it toward the opposite plate through the glass envelope-less than 1 pF is required. However, on 21 and 28 MHz the parasitics took over in a spectacular fashion. The only way they could be tamed was by using resistive stoppers between grid and ground. However, a little circuit analysis shows that this makes the neutralizing null and void with resultant operating-frequency instability. No such problem was ever en-

*Communications Engineering, third edition, Everitt and Anner, McGraw-Hill, page 407.

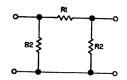
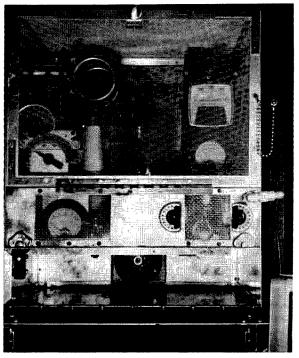


Fig. 2. 3-dB isolating pad. R1 consists of twenty 360-ohm, 1-watt composition resistors in parallel—total resistance 18 ohms. Each of the pad resistors labeled R2 consist of thirteen 3900-ohm, 2-watt resistors in parallel—total resistance 300 ohms.*

countered with the 3-400Z's.

Right up until nearly the end of the experiments, it had been hoped that a shielded link coupling could be used between the tank and the antenna. Unfortunately, the coupling obtained with the link proved to be quite insufficient on 21 and 28 MHz and the output transformer had to be introduced. It was also necessary to come to terms with the fact that the load impedance seen by each tube for the target outputs is in the vicinity of 5500 ohms. Using the old rule of thumb that a Q of 6 is adequate with push pull, the capacitance required works out to about 6 pF on 28 MHz, 8 pF on 21 MHz, 12 pF on 14 MHz and so on. Since the output capacitance of the 3-400Z is 4 pF and strays will

*For construction hints, see K. Glanzer, 'T-Pads for RF Circuits,' CQ, July 1964.



VE3AAZ's push-pull grounded-grid linear amplifier. In this view the underside of the chassis is opened up to show the blower. The screen door across the rf compartment permits changing the final plug-in coil.

Plate Coils—Both Sides

3.5 MHz 18 turns #14, 21/4" long, 23/8" ID, shunted by 25 pF vacuum capacitor at high end of band; shunted by 35 pF vacuum capacitor at low end.

MHz 12 turns #12, 21/4" long, 23/8" ID, shunted by 10 pF vacuum capacitor.

14 MHz 8 turns 1/4" silver-plated copper tubing, 21/4" long, 23/4" ID.

21 MHz 6 turns 1/4" silver-plated copper tubing, 21/4" long, 23/8" ID.

28 MHz 4 turns 3/8" silver-plated copper tubing, 21/4" long, 25/8" ID.

LI-Input Pi Network

3.5 MHz 8 turns #14, 2" long, 11/2" ID.

MHz 5 turns #14, 134" long, 11/2" ID.

14 MHz 3 turns 1/8" silver-plated tubing, close wound, 11/4" ID.
 21 MHz 2 turns 1/8" silver-plated tubing, close wound, 11/2" ID.

28 MHz 2 turns 1/8" silver-plated tubing, close wound, 7/8" ID.

Coil Construction

The input rf transformer is wound on an Indiana General CF-117° toroid %" thick 1%" OD., 1%" ID. The primary consists of a 0.010 copper strip, 3/16" wide, placed next to the core. The pushpull secondary winding consists of 150-ohm twin lead wound over the primary strip; 14 turns for 80, 40 and 20 meters, 12 turns for 20, 15 and 10.

The output transformer is wound on an Indiana General CF-124 form 1/2" thick, 2" ID and 31/2" OD. The primary consists of a 0.010 copper strip, "wide placed next to the core. The push-pull secondary winding is made from two %" wide 0.010 copper strips; insulated by #9 Teflon tubing and wound over the primary strip; 9 turns for 80, 40 and 20, 7 turns for 20, 15 and 10. Two CF-117 cores are mounted in the center of the larger core as shown in photographs.

These cores from Indiana General are available in two different materials designated Q1 and Q2. Material Q1 has a nominal relative permeability of 125, while Q2 has a nominal relative permeability of 40. In the both the input and output cores used in this linear, O1 cores were used for 80-20 meters, and Q2 cores were on 20, 15 and 10.

*Indiana General cores may be purchased from Permag Corporation, 88-06 Van Wyck Expressway, Jamaica 18, New York.

account for an additional 10 pF or so, we are just not going to be able to meet our specification. It is only a slight comfort to know that parallel connection and a Q of 12 would call for 12 pF on 28 MHz-8 pF being contributed by the tubes. Nor can we evade the issue by dropping the plate voltage and then calling for lower load impedances to give the rated power. When the "C" is too large and the "L" is too small we lose power in the tank circuit; if we drop plate voltages, we sacrifice plate efficiency and lose power at the plate. The only way out seems to be to use as large a coil as possible and keep its losses low-silver plated copper tubing was used here for the coils with jumbo banana plugs and jacks. In any case, be prepared to accept the drop in power as frequency rises with good grace. For these reasons no L/C values are shown in Fig. 1 anyone wishing to copy the design will have his own approach to this matter-he might even have a split-stator vacuum variable in the junk box! I didn't.

Power and distortion

It has become fashionable to rate linear amplifiers at so many watts PEP input. Aside from the rather impressive numbers generated, there seems to be little to recommend the practice. It is far more meaningful to quote the CW output and the PEP output consistent with good linearity-and with due respect to legal restrictions on power input.

With a 1 kW dc input, this amplifier yields at least 600 watts output on the 3.5, 7, and 14 MHz bands, shading off to 550 watts on 21 MHz and 500 watts on 28 MHz. The PEP output with good linearity is at least 1 kW on the low bands tapering off to about 800 watts on 28 MHz. The drive powers range from 20-40 watts, but the driver has to deliver twice this power since one-half is lost in the 3 dB pad. The power gain in the linear itself then is at least 20.

Distortion figures must of necessity describe all of the system up to the point of measurement. The published specifications for the B & W 6100 are: harmonics-50 dB or more down; intermodulation products-35 dB or more down. These figures can be met at the output of this linear driven by this exciter. Without becoming involved, therefore, in any attribution of distortion components, this amplifier does not measurably degrade the signal.

. . . VE3AAZ

A Frequency Calibrator for the VHF Man

For VHF DX and meteor-scatter schedules, you must know what your operating frequencies are. This calibrator will give you the answer.

If You've ever listened to the "VHF Nut Net" on 3815 kHz, Mondays at 0500 GMT, you've heard the elaborate scheduling between stations for long-haul VHF QSO's. The current schedules are mostly on two meters, near the bottom end of the band, via meteor-bursts. The frequencies quoted are usually given in kHz above 144 MHz, and these serious VHF'ers mean it when they say 144.013 MHz.

While most serious VHF'ers can be on at least one two-meter frequency to a tolerance of \pm 100 Hz, there are occasional apparent errors. These show up in the comments on the "VHF Nut Net" like: "I listened for you on 144.006 MHz last Wednesday, but didn't copy. I did hear a few 'pings' up at 144.008 MHz, though. That couldn't have been you, could it?"

To assure oneself of being on some arbitrary VHF frequency to within 100 Hz is no easy task. If we could operate "right on" 144.000 MHz, it wouldn't be so hard to check; but that isn't the usual case. Rather,

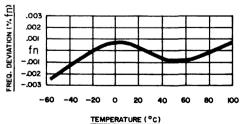


Fig. 1. Typical temperature curve of an 8 MHz AT-cut crystal. Note that the crystal frequency varies up to 0.0015% from 10° C to 40° C, a normal shack temperature range.

we are usually required to use a VHF frequency that isn't the harmonic of any of the usual standard frequency sources.

There are a number of ways of making frequency measurements of VHF signals, and they all have limitations. Basically, the problem is that we are trying to make a very precise measurement; 100 Hz in 144,000,000 is better than one part in a million. To see why stations are not always on frequency, see the frequency versus temperature curve of a typical 8 MHz AT cut crystal in Fig. 1. Notice that over the range from 10° C to 40° C, a reasonable "shack" temperature range, the frequency of the crystal can vary about .0015%. This much variation is over 2 kHz, when multiplied up to 144 MHz.

A logical extension of the principles used to calibrate high-frequency receivers has been used on 144, 220, and 432 MHz¹. This is simply the use of a very fast switch in the harmonic generator section of a 1 MHz calibrator. With a tunnel diode, or snap diode, doing the switching, useful harmonics spaced 1 MHz apart can indeed be generated through 432 MHz.2 This method is really the brute-force approach, since the harmonics we are interested in, in this case, are the 431st, 432nd, and 433rd, Harmonics spaced at 100 kHz intervals could, also, be generated in the same way, but then the harmonics of interest would be the 4310th through the 4330th!

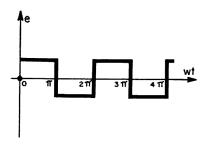
As most hams know from experience, harmonic amplitude decreases as we look for successively higher ones. This is predicted

12 73 MAGAZINE

in detail by Fourier Analysis* of nonsinusoidal waveforms. Several nonsinusoidal waveforms are shown in Fig. 2, with their Fourier series to illustrate this. Note that the harmonics of these two different waveforms drop off at different rates with frequency. However, both do drop off as 1/n or faster (where n is the harmonic number). Therefore, in a 100 kHz interval calibrator for twometer use, we can expect to have less than 1/1440th of the signal for calibration at 144 MHz if the rate of fall off of the Fourier series is 1/n. If the fall off rate were 1/n², we would have only 1/(1440)2th. A one volt 100 kHz signal, then, can theoretically produce a 1440th harmonic of about $0.5 \mu v$, if the series falls off as 1/n². Extension to 10 kHz-spaced marks will further reduce harmonic levels by a factor of between 10 and 100 (depending on whether the fall off rate is 1/n or $1/n^2$ respectively). To top all this off, it can be rather interesting to determine "which picket is which" in this "picket-fence" of harmonics that we've succeeded in generating.

The VHF calibrator presented here attempts to solve the fundamental problems of the brute force approach by applying techniques that are used in modern frequency-synthesis. The circuitry is admittedly

*Fourier analysis is a mathematical method whereby a series of sine and cosine terms of the integral multiples of frequency are used in evaluating the harmonics of complex waveforms.



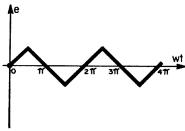


Fig. 2. Two nonsinusoidal waveforms which may be used for harmonic generation. The Fourier series of the square wave indicates that harmonics fall off at the rate of I/n, where n is the harmonic number. The harmonics of the triangular wave fall off at the rate of I/n².*

*For those of you are so inclined, the Fourier series for the square wave in Fig. 2 is $e = A_1 [\sin (\omega t) + 1/3 \sin (3\omega t) + 1/5 \sin (5\omega t) + 1/7 \sin (7\omega t + \dots 1/n \sin(n\omega t)]$. The Fourier series of the triangular wave in Fig 2 is $e = A_2 [\sin (\omega t) - 1/9 \sin (3\omega t) + 1/25 \sin (5\omega t) - 1/49 \sin (7\omega t) + \dots - 1/n^2 \sin (n\omega t)]$. From the last term in these equations it can be seen that the harmonics of the square wave fall off at the rate of 1/n, while the triangular wave harmonics fall of at $1/n^2$.

more complex, but the use of integrated circuits helps considerably to ease the con-

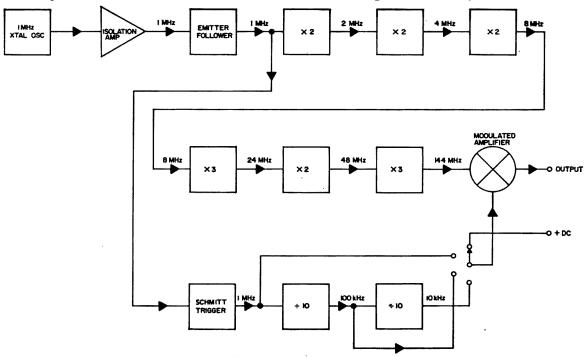


Fig. 3. Block diagram of the VHF man's calibrator.

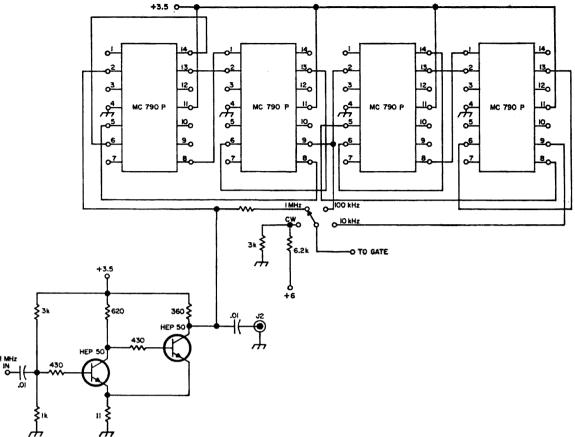


Fig. 4. Divider section uses integrated circuits to a 1 MHz crystal. The unmarked resistor in the 1 struction job as well as to reduce the cost. This two-meter calibrator offers a choice of calibration modes: 144 MHz alone, 144 MHz ± 1 MHz, 144 MHz ± 100 kHz, or 144 MHz ± 10 kHz. The mode-switching allows one to go from a rough 1 MHz interval frequency check to a 100 kHz interval check, and finally, to a 10 kHz interval check.

The system is described in Fig. 3. Note that the 1 MHz crystal standard is both multiplied-up and divided-down. We pro-

generate 10 kHz and 100 kHz marker signals from MHz should not be there—short it out.

duce, by means of a rather ordinary frequency multiplier chain, a clean 144 MHz CW signal that is exactly 144 times the frequency of the 1 MHz standard. This 144 MHz signal is then modulated by a rectangular wave at 1 MHz, 100 kHz, or 10 kHz; this modulation produces the desired marks. The main difference between this method and the brute-force approach is that our markers now fall off in amplitude as we move away from 144 MHz (in either direc-

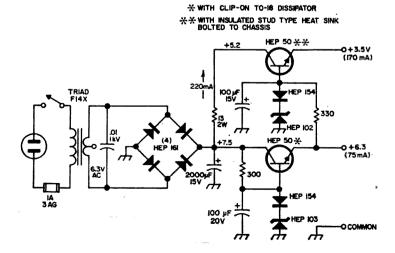


Fig. 5. Power supply section for use with the integrated circuit divider of Fig. 4.

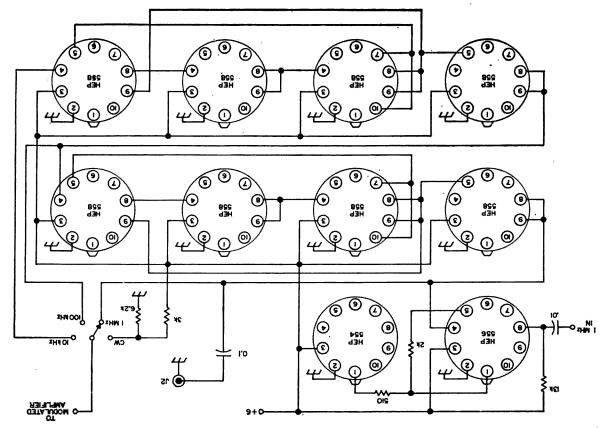


Fig. 6. Divider circuitry using HEP 558 J-K flip-flops to replace the MC790P RTL IC's which are inherently slower.

tion in frequency). Because we are now only interested in harmonics of the modulation frequency that are of relatively low order, the rectangular wave does not have to have a nanosecond rise or fall time. The "modulation" is not of the linear sort that hams usually encounter, since the rectangular wave essentially turns the signal off and on.

The circuit diagram is shown in Fig. 4. Note the use of digital integrated circuits. The internal circuitry of the individual IC's isn't shown since it would make Fig. 4 vastly more complex. The Motorola HEP line of semiconductors is used for the most part, except for the four dual J-K flip flops, These J-K flip-flops are wired to divide 1 MHz by two decades. The MC790P flip-flops (Motorola) are members of a logic family called RTL (Resistor-Transistor-Logic) which is inherently slower than MECL (Emitter-Coupled Logic), to which the HEP digital integrated circuits belong.

If you wish to use HEP 558 J-K flip-flops to replace the MC790P's, the circuit changes of Fig. 6 should be used. Since the HEP digital IC's are designed for +6 volts, a much simpler power-supply and regulator are used. The IC Schmitt trigger is of a

somewhat different design than one in a previous article by the author, and follows a technique outlined in a recent Motorola application note.^{3,4}

The crystal oscillator sections, in both versions, use an FET as a Miller oscillator. The Miller oscillator was used here because the DC9AJ crystal (1 MHz) was designed for that type of circuit, and has one side of the crystal grounded to the crystal can. Following the crystal oscillator is another FET, operating as a Class-A isolation stage. The isolation amplifier feeds an emitterfollower that in turn drives both the "countdown" and the "multiply-up" portions of the

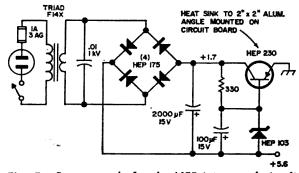


Fig. 7. Power supply for the HEP integrated circuit divider of Fig. 6.

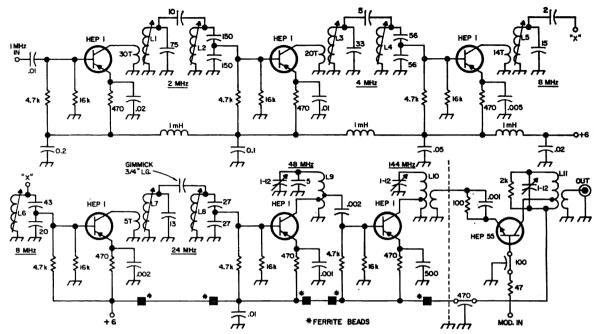


Fig. 8. The times 144 frequency multipler. A crystal controlled input at 1 MHz provides an output at 144 MHz. Coil information for this circuit is given in Table 1.

circuitry. The low output impedance of the emitter follower is needed primarily to drive the first multiplier.

The multiplier chain is conventional in its design—x2, x2, x2, x3, x2, x3—a total multiplication of 144. In the four lowest frequency stages, double-tuned interstage coupling is used. This double-tuning is to prevent the possibility of any 1 MHz, 2 MHz, 4 MHz, or 8 MHz side-frequencies from appearing around our 144 MHz signal when S_z is in the CW position. All the multipliers are PNP mesa transistors, operated "up-side-down" so that the +6 volt supply feeds their emitters. The modulated amplifier is a grounded-base stage, with the base as the modulation-control element.

Tuning of the multiplier section is easily

accomplished with a grid-dip meter used as an absorption frequency meter. The divider section can be checked by loosely coupling the output of S₂ to a high-frequency receiver and listening for the various harmonics, say at 80 meters. If the divider section is wired correctly, it will put out the right frequencies.

Checking the divider section with a high-frequency receiver, points out a potential problem. If the frequencies generated by the divider section are allowed to get into the receiver that is used as an *if* for your VHF converter, confusion will reign. The overall shielding of the calibrator, the general supply lead decoupling, and the VHF bandpass nature of the modulated amplifier are adequate to prevent such a problem in the units

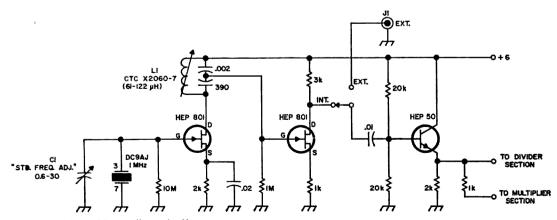


Fig. 9. One MHz oscillator-buffer section.

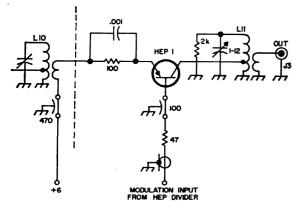


Fig. 10. Modulated amplifier for use with the HEP divider section. This circuit replaces the last HEP 55 stage in Fig. 9. when HEP IC's are used.

shown.

However, 1 MHz harmonics can be purposely coupled out (from the Schmitt Trigger) via J₂. These 1 MHz harmonics are used to beat with WWV on 5, 10, 15, or 20 MHz (in a high frequency receiver), for calibrating the 1 MHz crystal oscillator.

Operation of the calibrator would then be as follows. Couple the 1 MHz harmonic output (J₂) to the receiver with a small (5 pF) capacitor. Tune in WWV on the *highest* frequency that provides satisfactory reception. Adjust C₁ (the 1 MHz crystal oscillator frequency control) for zero beat. Zero beat is best observed on the "S" meter of the receiver. This is because the low-cutoff frequency of the receiver audio amplifier won't pass near-zero beat notes for aural monitoring. Disconnecting the cable from J₂,

Table 1. Coils used in the times 144 frequency multiplier

- LI = CTC (Cambion Thermionic Corporation)
 X2060-7 with 30 turns #28 on primary
 winding.
- L2 = CTC X2060-7
- L3 = CTC X2060-6 with 20 turns #28 on primary winding.
- L4 = CTC X2060-6
- L5 = CTC X2060-5 with 14 turns #28 on primary winding.
- L6 = CTC X2060-5
- L7 = CTC X2060-1 with 5 turns #28 on primary winding.
- L8. = CTC X2060-1
- L9 = 10 turns Airdux 416, collector tap at 21/2 turns, base tap at 3 turns.
- LIO = 71/2 turns #12, 1/4" inside diameter. Collector tap at 3 turns. Secondary is 2 turns #20 solid insulated hookup wire.
- LII = 7 turns #12, 1/4" inside diameter. Collector tap at 2 turns. Secondary is 11/2 turns #20 solid insulated hookup wire.

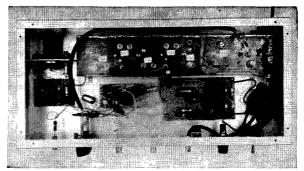


Fig. 11. Construction of the calibrator illustrated schematically in Fig. 4. Motorola MC790P dual RTL J-K flip-flops are used in the divider section.

the VHF output of the calibrator (J_3) is coupled to the VHF converter by means of a directional coupler and attenuator. The total decoupling between the calibrator and receiver should be about 50 dB. A temporary expedient for coupling the receiver to the calibrator may be used: a 6 to 12 inch piece of wire is simply connected to J_3 to radiate the calibrator output into a nearby antenna.

S₂ is first put in the "CW" position and 144 MHz found on the receiver. Then the switch is set to "1 MHz" and 144, 145, 146, 147, or 148 MHz found (which ever is closest to the desired operating frequency). Then we switch to "100 kHz", and finally to "10 kHz", selectively pinning down our frequency.

If desired, another decade could be added to the count-down circuits to give 1 kHz intervals. Also, another tripler could be added to the multiplier chain, making the calibrator useful at 432 MHz.

Another intriguing possibility is the use of WWVB (60 kHz) or WWVL (20 kHz) as a calibration signal. By using a divide-by-five circuit on the 100 kHz output of the first decade divider, a 20 kHz signal for

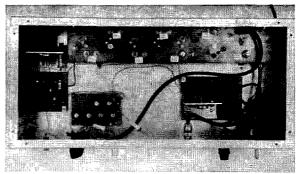


Fig. 12. VHF calibrator built with HEP 558 J-K flip-flops in the divider section. This photograph shows the unit in early stages of construction, with only one decade of dividers in use. Later four more HEP 558's were added to provide a second decade.

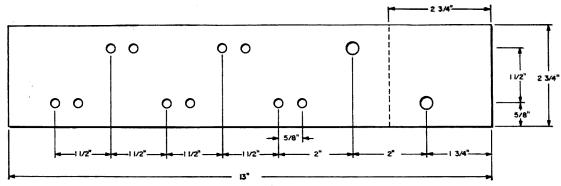


Fig.14. Template for the top plate of the multiplier assembly.

comparison with WWVL is produced. By simply putting this 20 kHz rectangular wave (which is rich in third harmonic power) into a 60 kHz tuned amplifier, a 60 kHz signal is produced for WWVB comparison.

You might ask why we didn't divide 100 kHz by five and then 2 to obtain 10 kHz, allowing a 20 kHz pick-off after the divide-by-five section. That was not done because it produces a *symmetrical* 10 kHz square wave for calibrator use. This type of wave-form has very small even-harmonic power.

Construction of both units was in modular form, with the individual modules enclosed in a 8 x 17 x 3 inch aluminum chassis which serves as a cabinet. Fig. 11 and 12 show the two calibrators built by the author.

The multiplier chain assembly (which also contains the 144 MHz modulated amplifier stage) is built from copper laminated board which is used in making etched circuits. This material is easily sheared, drilled, punched, reamed, and soldered. The bottom view of one of the multiplier chains is shown in Fig. 13 and its top-plate template is shown in Fig. 14. Note in Fig. 13 that alternate multiplier stages have their transistor cans inverted; this was necessary because of the The coils were coil-mounting positions. mounted on alternating sides of the "strip" to assure stability since there is no shielding between multipliers. There is a shield between the 48 MHz to 144 MHz tripler

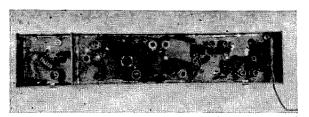


Fig. 13. Bottom view of the multiplier section of the VHF calibrator. A second tripler section could be added for use on 432 MHz.

and the 144 MHz modulated amplifier stage, of course.

Except for the crystal oscillator, capacitor C, and inductor L₁, the crystal oscillator circuitry is built on a piece of Vector board (64AA18). The crystal, C₁ and L₂, are mounted next to the oscillator board on a metal bracket. The metal bracket is positioned so that L₂ and C₃ may be adjusted through two holes in the rear of the cabinet.

The power supply is also built on Vector board except for the transformer and one of the regulator transistors in the dual-voltage version.

The divider units are also built on Vector board. Vector 64AA18 is used in the unit with the HEP IC's with holes in the board in which to mount epoxy HEP 451 sockets. The divider unit that uses MC790P type IC's is constructed from Vector 85G24EP because the hole-spacing is adaptable to the IC pinspacing. Vector pins (T28) are used for this 85G24EP board, whereas Alden 65IT terminals are used for the 64AA18 board.

The calibrators described above have proved very useful in two-meter frequency measurement, both in measuring meteor-scatter stations' frequencies and in accurately measuring MARS frequencies at 143,950 and 148.010 MHz. Though somewhat more complicated than most calibrators, either can be built in a few evenings of persistent fabrication.

... W6GXN

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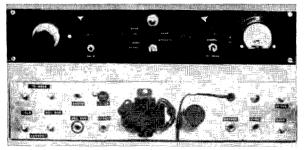
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The Semi-RTTY System

A high performance solid-state AFSK oscillator and tuning unit for the RTTY man. Silicon controlled rectifiers are used to drive the printer magnet.

Early in 1966 I acquired an RTTY printerkeyboard and started building gear to get it on the air. I'm strictly a six-meter man, so it had to be AFSK. Two articles had appeared in ham magazines which caught my fancy and I decided to use their ideas for my system.



Front and back view of the Semi-RTTY unit. On the front panel, top, the AFSK is to the left, the TU on the right. The ten turn pot on the extreme left is not used. In the back view, bottom, the TU controls are on the left, AFSK on the right. The power transformer and filter capacitor are mounted in the center.

The first was by a friend in Nebraska, Gene Austin, WØLZL, on a thyratron tuning unit. I wanted my system to be all solid state, so I started adapting Gene's ideas to a silicon controlled rectifier (SCR). To cut a long story short, Gene's system of feeding the output of each filter to a thyratron did not work for me—both SCR's turned on at the same time from noise pulses, etc. About this time I ran across a discriminator circuit which I thought would be ideal to prevent the above situation if a suitable triggering circuit could be devised for the SCR's.

The second article was by Tom Lamb, K8ERV.³ I built his circuit as described, but never used it on the air; I was dissatisfied with the shape of the signals generated by it. I'm sure this could have been cured by more carefully selecting filter components. However, being basically lazy, I decided to concoct something simpler and more straightforward. The upshot is a simple phase shift oscillator with a variable shift network.

Top view of the Semi-RTTY system. The tuning-unit circuit board is on the right. The FET in the AFSK oscillator is soldered to the pot in the upper left hand corner of the chassis.



As I built the AFSK unit described by K8ERV I was disturbed by the idea of generating a non-sinusoidal signal and then filtering out all but the fundamental component. It seemed that too much care had been devoted to selecting components for the filter. Also, his system involved some 45 components excluding the power supply-my junkbox wouldn't stretch that far.

The phase-shift oscillator which replaced K8ERV's circuit has the good points he required in his article-equal mark and space output levels, no switching transients, isolation from the keyboard, a simple shift system-plus the advantages of lower cost and

simple adjustment and operation.

The phase-shift oscillator is the simplest circuit I could find in common transistor circuit handbooks.5 Two basic changes were made to this circuit. First, R₁ was made adjustable to set the mark frequency (2125 Hz). Secondly, R₂ is tapped and an FET placed between the tap and ground.

An FET will conduct as long as the gatesource and gate-drain junctions are not reverse biased.2 With the gate grounded, the U112 FET exhibits about 500 ohms between source and drain. However, when a positive voltage (greater than 6 volts for the U112) is applied from gate to source, the U112 is "pinched-off". In the pinched-off state the resistance from source to drain is extremely high and can be considered to be infinite for our purposes.

With positive voltage on the gate of the U112, the phase-shift circuit is unaffected and the mark frequency can be set with R₁. When the gate is grounded (positive signal removed) the U112 conducts, placing 500 ohms across a portion of R2, lowering the resistance of this arm of the phase-shift network, and raising the frequency of the oscillator. In this state, the space frequency (2975 Hz), can be set with R₂.

As long as a voltage greater than six volts is applied to its gate, the U112 will be

pinched-off. This gives complete isolation from any resistance changes in the keyboard—if the divider network is properly designed. The circuit values shown draw a little less than 10 mA through the keyboard contacts to keep them clean, and any changes in keyboard contact resistance are small compared to 3k ohms.

The positive signal for the gate can be derived as shown, or from the printer local loop. In either case be sure to have a small resistor from gate to ground. The input resistance of these devices is so high that a charge on the 10 pF gate-source capacitance will take a long time to decay (the better part of a second!) unless shunted by a much smaller resistance. The decay has the effect of slurring the markspace transition, and is slow enough to be easily heard. Also, be sure not to exceed the gate-source breakdown voltage, listed as 20 volts maximum for the

Output of the oscillator is several volts peak-to-peak. The fixed resistor in the collector circuit isolates the output load from the phase-shift network. Without this, set-

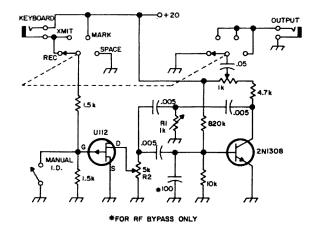


Fig. 1. The AFSK phase-shift oscillator used in the Semi-RTTY system. This circuit features equal mark and space output levels, no switching transients, isolation from the keyboard and a simple shift system—an FET used as a resistor.

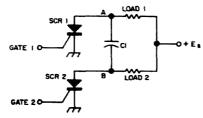


Fig. 2. Basic SCR circuit which is used to drive the printer magnet.

ting the output pot to the collector end loads the network and reduces the frequency of oscillation. The oscillator as shown is sensitive to supply voltage changes so a regulated supply is necessary. In its simplest form the AFSK oscillator can be built into a small minibox for around \$10.

The terminal unit posed more of a problem. There are several good transistorized circuits available, but they all use 30 volts or less to drive the selector magnet. When I was having trouble with my original converter, a friend pointed out that the selector magnet would not pick up properly unless the change of current versus time were large; this requires a large voltage driving the magnet. My printer would not print properly with a 20 volt supply, but with a 100 volt supply it would (both at 60 mA, of course). A solution to this problem might be to purchase some of the high-voltage transistors available. However, the ham fund was low and the SCR's were on hand, so they were used.

As mentioned in the introduction, the SCR equivalent of the thyratron commutator was used.⁷ This is simply a method of switching a dc load on or off using two SCR's. Essentially, when SCR₁ is on, and SCR₂ off, point A is grounded and load 1 is activated. When a positive control signal arrives at the gate os SCR₂, it turns on, grounding point B. Capacitor C₁ has been charged to the supply

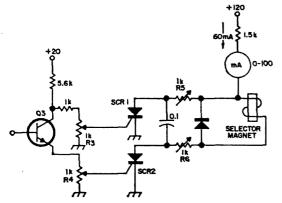


Fig. 3. The complete SCR printer-magnet driver circuit with the trigger, Q3.

voltage and grounding point B applies a negative voltage to point A, the anode of SCR₁, turning it off. SCR₁ will stay off if its gate is less positive than the necessary trigger signal. A signal at the gate of SCR₁ will reverse the action. With this commutator to carry the current for the selector magnet (at any voltage up to several hundred), the only requisite was to find a suitable triggering circuit.

Fig. 3 shows the triggering circuit, along with the actual SCR circuit in use with my printer. With Q₈ off, there is no voltage across R₄ and about 3 volts across R₃, which can be set so that SCR₁ fires. When a positive voltage is applied to the base of Q₃, turning it on, about 3 volts appears across R₄, which can be set so that SCR₂ fires. The voltage across R₃ drops when Q conducts, removing the gating signal from SCR₁. When Q₃ is turned off the action reverses again.

With this circuit in hand it is a simple matter to adapt one of the discriminators to drive the switch. Fig. 4 shows the whole circuit. Diodes 1 and 2 provide simple limiting This is adequate for strong signals. For weaker signals, a bandpass amplifier with AGC might be added ahead of this circuit. The rest of the circuit is self-explanatory except for R₂. This provides no-signal bias to Q₃.

Tunable inductors were used for two reasons. First and foremost, they were in the junk-box. However, with tunable inductors, adjustment of the discriminator is very easy.

Tuning the system is very easy. Place the reversing switch to "normal" and the stand-by switch to "standby". Apply a mark signal (2125 Hz) to the input and a VTVM to the test point (TP). Tune the mark filter for maximum voltage at TP. Switch the input to a space signal and tune the space filter for minimum voltage at TP. With a large enough signal, this voltage should go negative.

Remove the signal and vary R_2 through its range. The voltage at TP should go from zero to some maximum, with a sharp knee around 3 volts. This knee marks saturation of Q_3 and should be noted. R_2 is set so that the no-signal voltage at TP is midway between zero and the saturation point.

Now apply a mark signal again and adjust the gain so that Q_3 saturates. Switch to a space signal and the voltage at TP should go negative. If the voltages from the discriminator are not symmetrical, adjust R_2

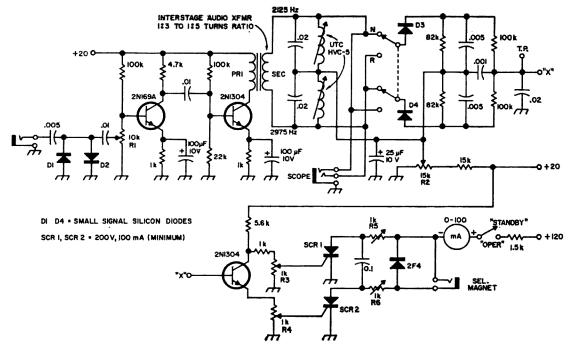


Fig. 4. Circuit of the complete semi-RTTY tuning unit.

slightly so that a reasonable signal will sat-photographs. Operating controls are on the urate Q_3 on mark and cut it off on space. front panel. Frequency and current adjust

Set R₃ and R₄ to ground and R₆ and R₅ to their midpoint. Apply a mark signal and switch the standby switch to "operate". Increase R₄ slowly until SCR₂ fires. This is noted by the jump in current and by the selector magnet pulling in. Adjust R₆ for the desired 60 mA. Now switch the input to a space signal. Increase R₈ slowly until SCR₁ fires. This should be noted both by a change in the current and by the selector magnet dropping out. Adjust R₅ for the same current as drawn by the selector magnet. A little playing around with R₃ and R₄ may be necessary to get the proper switching action from a weak signal. Now tune in a station and listen.

The power supply I built is not shown because it uses a special transformer I salvaged from an old pin-ball machine. Besides, no ham builds power supplies exactly as they are published. As mentioned above, a zener regulated supply is necessary. The high voltage supply uses a simple half-wave rectifier with RC filtering, the 1500 ohm current limiting resistor is included as part of the power supply. The regulation on this supply is not too important, as long as it will supply the 60 mA and maintain 100 volts or more.

Both the AFSK oscillator and the tuning unit are built into a 3½ inch relay rack panel and recessed channel as shown in the chotographs. Operating controls are on the front panel. Frequency and current adjustments are on the back, along with all jacks, the fuse, and power supply components. The AFSK oscillator is built onto a small circuit board attached to the front panel. The tuning unit is built on a similar board mounted parallel to the panel. The photographs show a ten-turn pot on the left. This is not used and the space may be large enough to mount a 1" scope for tuning, if the desire and funds so prescribe. The transistorized scope by K8ERV should be ideal.

This unit has been giving good copy on 40 meters and 6 meters, new services, several Spanish stations and lots of garble. All signals are obtained with my BC-455 Command set (6-9.1 MHz). On the weaker stations, garbled copy from fading is annoying and the bandpass filter with AGC as mentioned above would be valuable.

I would like to thank my friend Bill Perkins for help with the photography.

. . . KØJXO

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Mobile Power - The Alternator

Most mobile operators are especially interested in their power system — W9NLT describes the modern alternator system and how it works.

Hams who are enthusiastic mobile operators have learned how important it is to have a power source that is reliable and stable. A poor power system can result in erratic operation and a high trouble rate in mobile equipment. It can also cause missed contacts, frustration and deep-seated feelings of inferiority in the operator. A lot of this kind of grief can be avoided by understanding and making design allowances in mobile gear for that most common source of mobile power—the alternator.

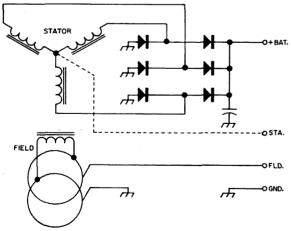


Fig. 1. Typical alternator schematic showing wyeconnected stator windings: the stator midpoint is brought out to a terminal only on Ford (Autolite) units.

While there are a number of alternator/ regulator systems, some characteristics are common to all of the recent models. To begin with, all of the alternators are designed to be mounted on the engine block; they are belt driven. The alternator pulley is about 3 inches in diameter while the driving (crankshaft) pulley is not less than 6 inches in diameter. As a result, the alternator shaft will turn at a speed that is at least twice the speed of the engine; a commonly found ratio is 21/2:1. Rotation is normally clockwise as viewed from the front (pulley end) of the alternator. It is important that the alternator be rotated in the proper direction; reverse rotation will cause the integral fan to move less air and the alternator may overheat if it is run at full load.

Alternators use a rotating field to which dc current is supplied through a pair of slip rings and carbon brushes. This arrangement permits the high output currents to be supplied directly from the stator windings without going through brushes or sliding contacts. Field current is usually less than 3 amperes for alternators that are rated at less than 50 amperes output. The rotating field is built with 6 pair of poles and so the output of any one stator winding goes through 6 electrical cycles with each revolution of the alternator shaft. The output frequency in hertz is

equal to one tenth of the shaft speed expressed in revolutions per minute. For example, if the alternator shaft is turning at 4000 rpm, the output frequency will be 400 Hz. Exception: the Delco-Remy alternators used in G. M. cars generally have 7 pairs of poles and produce 7 cycles per revolution.

The stator has three windings and it supplies 3-phase power; the windings may be connected in either the delta or wye configuration, the wye connection being the most common. The stator leads are connected directly to the internal rectifier which is made up of six silicon diodes. The diodes are mounted in the alternator and are arranged to provide full-wave rectification. The ripple frequency is six times the frequency developed in any one winding. At a shaft speed of 4000 rpm the ripple on the dc output will have a frequency of 2400 Hz (2800 Hz in G. M. cars). The rectifier diodes may be mounted on the rear end-bell of the alternator or on 2 separate plates (or a printed circuit board) mounted inside of the rear end-bell. Three of the diodes are built with their cathodes connected to their cases; the structure that they are mounted on is connected to the positive output (BAT) terminal. The other 3 diodes have their anodes connected to their cases which in turn are grounded to the alternator frame. Several makes provide a capacitor that is connected between the output terminal and the frame to protect the diodes from voltage surges; it also acts to suppress radio noise. A typical alternator schematic is shown in Fig. 1.

The dc output is a function of the shaft speed and the field current; an increase in either one will raise the output voltage. The alternator is self-limiting, however, in that when the shaft speed exceeds about 5000 rpm, the output does not continue to rise in proportion to increased speed. This effect is mainly due to the fact that the flux created by currents induced in the stator windings opposes the flux created by the rotating field. Designers call the phenomenon "armature reaction". Hysterisis losses in the stator also contribute to self-limitation. In all current models, the alternator output is regulated by changing the current in the winding of the rotating field.

The alternator output terminal is directly connected to the battery in all cases. Direct connection is possible because the reverse leakage through the diodes in the rectifier (less than 1 milliampere) is so small as to

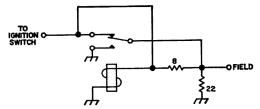


Fig. 2. Schematic of a single-relay regulator.

be insignificant. This arrangement eliminates the necessity to provide a relay having heavy contacts capable of disconnecting the alternator from the battery when the engine is not running as is done with dc generators.

Regulating systems

The regulator is made sensitive to the voltage of the auto's electrical system. To a lesser extent it also reacts to the ambient temperature, with slightly higher voltages being maintained at low ambient temperatures. The relationship of temperature to voltage is shown in Table 1.

Regulating systems fall into three groups. Some operate with relays alone, some with a combination of relays and transistors and some regulators are wholly solid-state. The simplest form of regulator consists of a single relay and two resistors as shown in Fig. 2. This arrangement is typical of the regulators used in cars built by the Chrysler Corporation. Battery power is picked up through the ignition switch. It is applied to the alternator field through the upper contact and the armature of the relay. The relay coil is connected between the ignition system terminal and ground. The action of the relay can be compared with that of a voltmeter, the armature acting like the indicating pointer of the meter. The voltage required to just pull the armature away from the upper contact would be the nominal voltage listed in Table 1. The additional voltage necessary to pull the armature to the lower contact would be from 0.2 to 0.6 volt greater than the voltage required to pull the armature away from the upper contact. When the electrical system voltage is low, the relay armature rests against the upper contact and the full system voltage is applied to the field winding.

As the battery becomes charged, the system voltage increases and the relay armature is pulled into a position between the upper and lower contacts. The opening of the upper contact places a resistance of about 8 ohms in series with the field, causing the field current to drop from some 2½ amps to about 1

ampere. A further increase in the electrical system voltage will cause the relay armature to close against the lower contact. In this condition the field lead is grounded and field current will drop to zero. A resistance of about 20 ohms is provided to absorb surges generated in the field winding and thus protect the relay contacts. In normal operation the armature will first rest against the upper contact for a short time after the engine is started. At moderate speeds it will vibrate against the upper contact and at road speeds it will vibrate against the lower contact (assuming the battery condition to be normal). The vibrating relay switches the alternator condition rapidly between full output and partial output or between partial output and no output. The rate at which the vibrations occur and the length of time that the relay armature rests against either contact is determined by the system voltage and the alternator response characteristic for the speed at which it is turning. While the average system voltage should be within the limits given in Table 1, the instantaneous de voltage (other than ripple) measureable in the electrical system will vary between 11.5 and 15 volts. It will change with each vibration of the relay armature, which might be as high as 100 Hz or so. Single-relay regulators provide no means of operating a charge indicator or "idiot light"; an ammeter must be used to show whether the battery is charging or discharging.

Some G. M. and Ford automobiles employ a two-relay regulator system. The two relays function in a way that permits the use of either an ammeter or a charge indicator lamp. A typical two-relay regulator is shown in Fig. 3. Some early Chevrolets employ a third relay, separately mounted, to operate the charge indicator lamp. In later models the relay was made an integral part of a three-relay regulator. Some G. M. autos are equipped with a relay-type of regulator that contains a power transistor which isolates the field coil from the relay. This arrangement contributes to longer relay contact

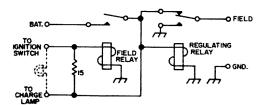


Fig. 3. Schematic of the two-relay regulator with a terminal for operating a charge-indicator lamp.

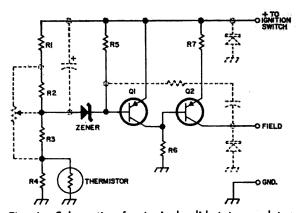


Fig. 4. Schematic of a typical solid-state regulator. Components shown connected by dashed lines are used by some manuafacturers, but not all of them.

life, making a more reliable regulator. One of Ford's arrangements uses a connection to the wye-connected stator neutral to operate a separately mounted field relay; the balance of the regulator is transistorized and contains a variable potentiometer for voltage adjustment. A significant characteristic of relay control is that there is a level of generator output between zero and full output, with the charging rate controlled by switching the generator rapidly between two of the three conditions.

Several auto manufacturers are now using solid-state electronic regulators. Included are American Motors, Checker, Ford, G. M. and several truck makers. The solid-state regulator offers a more stable and reliable control of the alternator output. It is free of the maintenance problems that arise from the aging of relays, pitting or wear of contacts and the effects of dirt accumulation. A schematic of a typical transistorized regulator is shown in Fig. 4. The regulator consists of two PNP transistors, a zener diode and an assortment of resistors. The regulator circuit is a two-state, high-speed switching network. The values of the components are chosen so that at voltages below the selected operating potential, the zener diode is non-conducting. The resulting positive potential that is applied through R₅ to the base of driver transistor Q₁ biases it to cutoff. With Q₁ cut

Table I
Charging voltage related to ambient temperature

remp.°F	Chrysler	Ford	G.M.	Motorola
0	_	_		14.6-15.4
25	_	_	Range	14.4-15.2
50	13.6-14.6	14.3-15.1	is 13.5	14.2-15.0
75	13.5-14.5	14.1-14.9	to 15.2	14.0-14.8
100	13.4-14.4	13.9-14.7	for all	13.8-14.6
125	13.3-14.3	13.8-14.6	temper	13.6-14.4
150	13.2-14.2	_	atures.	13.4-14.2

off, only a minute amount of current flows through R₀ and the base of Q₂ will be nearly at ground potential, biasing it to full conduction. In this condition the positive potential of the electrical system is applied to the alternator field through R₇.

As the electrical system voltage increases, there is an increase in the potential that appears between the base of Q1 and the junction of R₂ and R₃. A zener diode having a reverse breakdown or zener voltage of from 8 to 10 volts (depending on the manufacturer) is connected between these two points. When the zener breakdown voltage is reached, the diode conducts and the positive potential on the base of Q₁ is reduced. Q1 then conducts, raising the voltage developed across R₆ and biasing O₂ to cutoff. This interrupts the flow of current in the alternator field, causing the alternator to stop developing power. As the system voltage drops, the zener diode stops conducting, Q1 is again biased to cutoff, Q2 conducts and current flows to the alternator field. The switching action takes place so rapidly that it can go through as many as 2000 switching cycles per second. The key to transistorized regulator operation is the zener diode which acts both as a voltage reference and as a voltage actuated switch which initiates regulator action.

It is possible to add temperature correction to the regulator by using a thermistor. A thermistor is a special kind of resistor with a very pronounced negative temperature characteristic. Its cold resistance can be several times its hot resistance. The zener diode senses system voltage through the network of resistors R₁ through R₄. The thermistor is connected across R₄. As the temperature rises, the resistance across R₄ becomes less and a greater proportion of system voltage appears across the zener diode. The net result is that the system voltage will be regulated at a slightly lower voltage when the ambient temperature is raised.

A few components are shown in the schematic that should be discussed. Ford and G. M. regulators are equipped with a potentiometer in place of resistors R₂ and R₃ to permit a small range of regulator voltage adjustment. They also use a feedback circuit from the collector of Q₂ to the base of Q₁ to speed up the switching action, together wih diodes intended to protect the regulator from surges appearing on the field or igni-

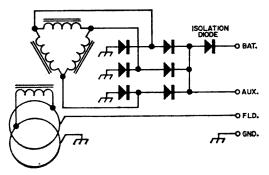


Fig. 5. Schematic of a Motorola alternator showing the delta-connected stator used in the 55-ampere model. Also shown is the isolation diode and auxiliary terminal connection.

tion leads. G. M. also places a capacitor across the combination of Rs and the zener diode to smooth out the voltage surges in the diode circuit. Fig. 5 shows the delta connected stator used in the Motorola 55 ampere alternator. It also shows the isolation diode used in all of the Motorola alternators. Use of the isolation diode makes the operation of a charge indicator lamp possible and it further reduces the small battery leakage through the rectifier diodes. Since there is a small voltage drop across the isolation diode, the alternator is designed to produce a slightly higher voltage than others. This voltage is present at the "AUX" terminal and is used for the regulator and field supply.

Hints for happy mobiling

One way of assuring yourself reliable mobiling—and motoring—is to *know* that your battery and its charging system are in good condition. Here are a few suggestions that you may find helpful:

1. Use only distilled water in the battery; keep it properly filled. Check the electrolyte level at regular intervals and after periods

of heavy charging.

2. Measure the specific gravity of the electrolyte occasionally; when fully charged it will measure 1.265 ± 0.01 at $80^{\circ}F$. Correct for temperature by adding 0.004 to the measured value for each 10° that the electrolyte temperature is above 80° ; subtract the same amount for each 10° that the electrolyte temperature is below 80° .

3. Provide a means of giving the battery a supplemental charge when it is needed¹; such occasions include periods after extensive winter night driving, when mobile activity (es-

 Schleicher, "A 12-Volt Battery Charger", CQ, May 1966. pecially testing in the driveway) has been heavy and whenever the generating system

is not in top form.

4. Regulators sense system voltage; if possible, equip your car with a good voltmeter. War-surplus aircraft style voltmeters and ammeters are still available at reasonable prices.

5. If you have equipped your car with a voltmeter, an ammeter or both, consult them often enough to know which conditions are

normal and which are abnormal.

6. Make this simple test occasionally to verify that your charging system is in good shape: with the engine running at the speed it would attain at the road speed of 30 mph, turn on the headlights (high beam), electric windshield wipers and heater fan. That will place a load on the electrical system of about 25 amperes. (If you don't have electric wipers, use the cigar lighter; it draws about 10 amps.) Under these conditions the charging system should maintain 13.5 to 14 volts at the battery terminals.

7. If your alternator system will not put out its rated current, look for such troubles as a loose fan belt, defective contacts or blown fuse wires in the regulator; test the voltage applied to the field terminal. If the above items are ok, then investigate the brushes for wear. The alternator bearing lubrication and diodes should be checked last since testing the diodes requires that the alternator be disassembled and the diode leads be unsoldered.

Some tips for experimenters

Automotive alternators can be arranged to supply 6 or 12 V dc, 60-Hertz or 400-Hertz power to mobile, emergency, or Field Day rigs. A gasoline engine rated at 2 or 3 horsepower makes an ideal prime moverkeep your eyes open for discarded power lawn mowers if you want a cheap engine. Used alternators are easy to find at most auto wrecker's yards for a few dollars. Both can be mounted on a piece of 1" lumber, leaving room for the regulator or field supply arrangement. The engine speed and alternator shaft speed can easily be optimized by using pulleys of the proper sizes and a V-belt. The alternator will be most efficient when operating at speeds in the range of 4500 to 5500 rpm. Small gasoline engines will develop their rated power at some speed between 2000 and 3000 rpm; this speed is often listed on the name plate or in the

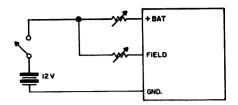


Fig. 6. Arrangement for adjusting the field current to a constant value when the alternator is used to supply ac.

instruction manual.

Even the smallest alternator made should be able to develop at least 350 watts of electrical power. Most alternators are wye connected and will furnish two dc voltages simultaneously if the common connection or neutral is brought out. (Ford Autolite alternators bring this point out to a terminal designated "STA".) The voltage across the arms of a wye connected three-phase generator or transformer is 1.73 times the voltage developed in one winding. The dc at the stator common is produced by three-phase, half-wave rectification, however, and so its ripple frequency will be only half that present on the regular dc output (BAT) terminal. Losses in the diodes, added to the above conditions, result in a dc voltage at the stator neutral that is approximately half that at the BAT terminal.

Residual magnetism in the alternator field is often so low that the output voltage will not "build up" until the field is excited by an external 12-volt source. Once the alternator is running and developing power it can be kept self exciting. If the alternator is to supply dc to the radio equipment, it is a good idea to leave the storage battery connected to smooth the ripple in the alternator output. With such an arrangement, any type of automotive alternator regulator should work satisfactorily. If the alternator is used to supply ac, it is better to use a rheostat for excitation control to avoid the on-off operation of the regulator. One such arrangement is shown in Fig. 6. The two rheostats are 10-ohm, 50-watt units and are adjusted to produce the proper field current while limiting the battery charging current to about 1 ampere. The lightest possible de load is recommended to avoid excessive flattening of the output waveform. The alternator output is a fairly good approximation of a sine wave unless it is supplying a heavy de load. A heavy de load will cause the output waveform to be severely clipped. When the alternator is self excited it is in

a positive feedback situation, i.e. as the field current goes up, the output voltage goes up, which in turn results in more field current. Under no-load conditions the alternator voltage could get high enough to damage the rectifier diodes, so when experimenting, bring the field current up from a low value rather than down from a high value.

Alternators can be used to supply 60-Hertz equipment. When turning slowly enough to develop 60-Hertz power, the alternator will be pretty inefficient and will require more field current than is normal. It is best to push the speed (and frequency) as high as the radio equipment will allow. Most radio equipment of good design will operate well on frequencies around 100 Hz if the power is supplied in the manner shown in Fig. 7. This kind of connection can be easily made to any receiver that is equipped with a socket for the supply of external power. Notice that filament power is supplied directly from the alternator; the filament winding becoming the transformer primary. In this condition the transformer is called on to supply only that amount of power that is required for B+ and for the rectifier tube filament. The reduction in total power transferred by

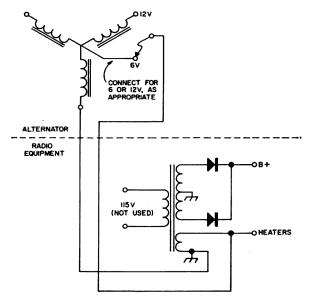


Fig. 7. A simple way to operate radio equipment from low-voltage alternator ac.

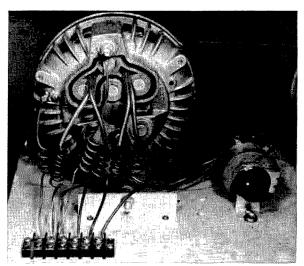


Fig. 8. Method of bringing leads out of the alternator housing without drilling holes in it.

the power transformer is one of the reasons that the equipment tolerates the higher frequency so well.

The arrangement shown in Fig. 7 can also be used well with 400-Hertz equipment. This is a particularly promising field for experiment since 400-Hertz power transformers of the highest (Military Spec.) quality are available at rock-bottom prices. They are a lot lighter than 60-Hertz transformers, too. When using the arrangement in Fig. 7, be sure to isolate the alternator frame electrically from the radio equipment. The more ambitious experimenter may want to isolate one alternator winding for use with the rectifier for field supply and use the other two for ac supply. Fig. 8 is a photograph showing how leads from the neutral and the three phases can be brought out of an alternator without drilling the case or mounting any additional terminals on it. While much of the foregoing presumes that the alternator will be driven by a small engine, it can also be mounted on an engine block as a special supply for mobile operation. Watch for wide voltage swings if this is done, and provide for protection of 400-Hertz equipment against excessive currents that can flow if the frequency drops radically.

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Visual Monitoring of Remote Carriers

What does your CW signal look like?

If I make it known during a QSO that I have a panadaptor (Heath Ham-Scan HO-13), I am nearly always asked to check keying characteristics; or if on phone, which I use on occasion, I am asked to check modulation. The Ham-Scan can do neither of these things. However, the thought occurred that keying and modulation could be checked if one could take a look at the other's carrier, and a handy place to look at an incoming carrier is at the last if stage before detection—so that's where we look.

Modulation checks are easy to make and I oblige. Inasmuch as hams are human and they want only compliments, I suppose this is a mistake. If you want a fast "73 es cul", tell him that he is splattering all over the place. On the other hand, why not let him earn a pink ticket on his own?

However, the main discourse here is CW keying characteristics. Keyed carriers can be studied at leisure—you needn't be in QSO with anyone. Just turn on your receiver and scope, tune around the CW portions of the band and watch. I'll describe the circuitry to accomplish this a little later.

There are almost as many different signals on the air as there are stations. I would suggest that whenever Official Observers send their friendly QSL's, they would include a sketch of the offender's signal. This would present more fact than opinion. The picture might suggest a fault to the signal's owner that he had been suspecting, but not

worrying about because all his reports were T9.

There seems to be an ideal keyed form listed in the ARRL Handbook, and it looks like this:

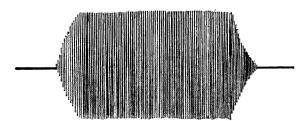


Fig. I.

In searching around for this ideal shaping, only one signal was found which was shaped thus, and it wasn't a ham station, not even a commercial, it was NSS. Not even WIAW can boast of the signal shape that it recommends; there is much left to be desired.

The nearest approach that could be found to the ideal looks like this:

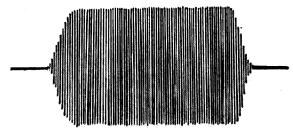


Fig. 2.

The slope of the leading and trailing edges suggests an absence of clicks. The carrier is smooth with no hum modulation. It is crisp and clean, and easy and pleasant to copy—assuming, of course, that the paddle manipulator is doing a good job. There are quite a few of these signals around I am happy to report, but percentage-wise they are far too few. There is one thing the form will not reveal—a chirpy signal. It can have good form and still sound poorly.

Another signal appears thus:

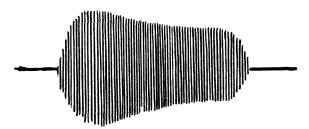


Fig. 3.

This signal sounds good. Matter of fact, it is hard to tell it from the previous signal. It suggests, however, that the power amplifier power supply regulation leaves something to be desired. There are quite a few of these signals on the air.

Here's one that probably does not generate broadband clicks, but does tend to sound clicky-thumpy.

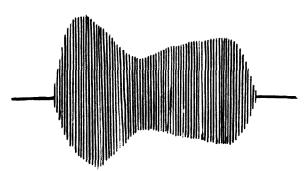


Fig. 4.

It's hard to describe, it seems overly crisp. However, for a QRQ hound, I think I would prefer it to some of the softer signals. The leading edge hits you with a loud bang and assists in resolving the characters at high speeds. I am unable to diagnose the reason for this particular shape except perhaps that somewhere in the transmitter there is a regulated power supply which loses control when the key is depressed, then begins to recover about the time the key is let up.

Though this may not look it, it has a pleasant and crisp sound, and is free of clicks.

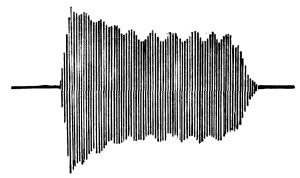


Fig. 5.

It is very similar to Fig. 3 except it is modulated by a test pest who has his key down for a long period. The scalloped edges produce the audible beat which adds to the pleasant sound (to me).

Here is one that's hard to figure. No clicks, no thumps—sounds clean and crisp.

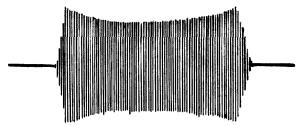


Fig. 6.

Fig. 7 will drive you frantic. This really should not be permitted on the air. The clicks were heard 15 kHz each side of the center frequency—in spite of a 500 Hz filter.

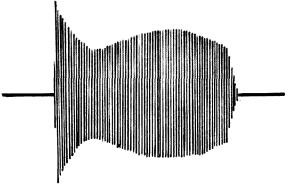


Fig. 7.

Here's a real shame. The main body of this pulse looks like the ideal. However, parasitics are probably messing the front of the pulse, then stopping until after the pulse is terminated. But what are those blobs trailing the main body?

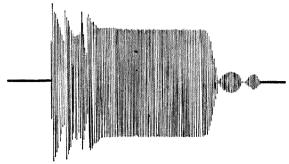


Fig. 8.

Perhaps it is relay bounce if keying relay is used. I seem to recall that this particular operator said something about time sequence keying which might rule out the keying relay in the amplifiers. Whatever it is, it sure messes up another fellow's QSO even 15 kHz away.

What's this mess? Actually, it is a noisy signal, probably with excellent keying characteristics, riding on the QRN—deep grass for sure, but surprisingly, this signal was very easy to copy. I would have given it a 539.

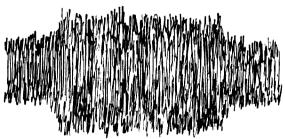


Fig. 9.

Fig. 10 shows a thumpy and mushy signal. I'm sure it is click free, but this is really hard to copy, and this particular one had chirp to boot.

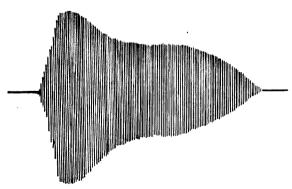


Fig. 10.

If the owner of this form could see his own signal (ARRL Handbook shows how), I'm sure he would try to do something about

it. However, the listener to whom this signal was directed gave the owner a 589. Like Linus' blanket, indiscriminate 589's make for false security.

Here's one that can boast of a good regulated power supply and plenty of key click filtering—as a matter of fact, the owner seems to have gone overboard in trying to eliminate key clicks.



Fig. 11.

It is too mushy and very hard to copy because one pulse trails off into the next one, producing an undulating sort of sound which is hard to define, and hard to copy beyond 10 words per minute. It has to be heard while seen.

Fig. 12 shows the same pulse as in Fig. 2, The difference is that for Fig. 12, the AVC was turned on. It can be seen that the AVC action has reduced the gain. The point is, when looking at CW signals, keep the AVC off. Otherwise, you will be adding characteristics to the signal that do not exist.

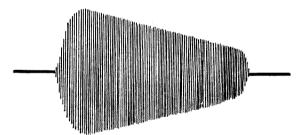


Fig. 12.

Here is a dandy. Fig. 13 developed very early in the design of the receiver modification. Actually these wiggles were the only things to be seen for a while.

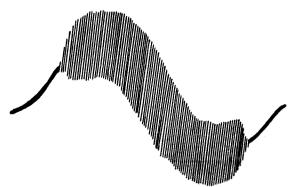


Fig. 13.

While trying to figure out this sausage pattern, the answer came unexpectedly. My wife had come into the shack to make some comment about chores still waiting to be done. I turned down the audio to hear what she had to say. Later, as I looked back at the scope to continue my observations, the sweep had straightened out. This was pretty frustrating because it sure looked like something intermittent had developed. I turned the volume back up to listen to the signal, and there was the sausage again. crookedness was proportional to the volume. Volume down, straight sweep; volume up, baloney. Poor regulation in the B+ line of my receiver was the cause.

May I suggest that you keep these pictures handy and if we ever bump into each other (low end of 80 early evenings), I will be happy to tell you what kind of signal you have by saying that it is similar to, or exactly like figure so and so. If you bump into someone else who has made this modification, let him tell you what you look like. It's fun watching the characters as you listen to them.

So far all the discussion has been on CW characters, mainly because there is such a variety, and it is my prime interest. However, don't discount the AM aspect. The modulated carrier envelope is a pleasure to watch—you can tell your QSO exactly how he is modulating, and on AM you can leave your AVC on, or off, as you wish. SSB signals are easy to monitor. Flat topping is very apparent. You can do all the monitoring as shown in the *Handbook*. In addition, you can monitor the other guy's carriers where the *Handbook* indicates only how to monitor your own. Do you like trapezoid patterns? Just plug the audio into the horizontal amplifier.

Now for the technical details. I said earlier that a good place to look at a carrier was at the last *if* stage before detection.

A cathode follower is added to the receiver. Inasmuch as this circuit presents about a 30-megohm load, the loading of the *if* is negligible. As a result of this connection, no trimming or touching up of the last *if* is necessary. The output of the cathode follower is brought out to a phone jack installed in a convenient place. Because the output impedance of this follower is approximately 180 ohms, plain unshielded wire was used between the cathode-follower output and the phone jack, keeping the wire close

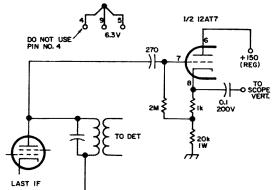


Fig. 14. Cathode follower circuit which is used to isolate the last if stage from the oscilloscope.

to the chassis, and not over a foot long.

Between the phone jack and the vertical input of your scope, use a piece of RG-58. Plain shielded wire will work fine if your second if is 50 kHz as are most double conversion jobs. Assuming that you use as much as six feet of plain shielded wire to connect your scope, about 300 pF of shunt capacity will be added across the cathode follower output. Sounds like a lot, but 300 pF at 50 kHz provides a reactance of about 10,000 ohms. When shunted across the 180 ohm output of the cathode follower, this will not produce any noticeable attenuation. At 455 kHz, the reactance of 300 pF would be about 120 ohms. When shunted across the follower output, the attenuation would be quite noticeable, but it will still work. However, if your scope has lots of gain at 455 kHz, it's still ok. The choice is up to you.

Your scope may need a small modification to produce a slower sweep than you normally have. I found that as low as two sweeps per second is very useful. The scope on the W3RMI operating console is a three-inch Heath Model 10-21 with a bandwidth of 200 kHz, more than adequate to handle 50 kHz signals. A capacitor and switch were added to produce the slow rate, as shown in Fig. 15.

. . . W3RMI

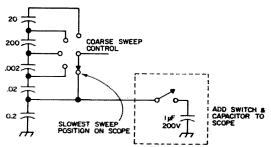


Fig. 15. Adding a capacitor to the scope's sweep circuitry to slow down the trace for CW monitoring.

How Much Power Are You

Losing Through High SWR?

This article will show you how to calculate the amount of your transmitter's output power that is being radiated by the antenna and the amount being lost in the feedline.

To perform this very important calculation, all you need to know is the SWR and the type of coax you have (the number is printed on the insulation).

Before we go into more detail, let's consider why this is important. First of all, it tells you how high an SWR you can tolerate without wasting most of your power melting ice off the coax. You may find that this SWR is considerably higher, or lower, than you thought; this depends on the frequency and the type of coax you use. Secondly, you can assume the superior attitude of an antenna expert toward any kid on 75 meters who doesn't show the proper respect for your two letter call.

Now, how do you measure SWR? Well, the easiest way is to buy an SWR bridge such as those distributed by Heathkit, Knight, Laffeyette, etc. These bridges are all essentially the same; they provide continuous monitoring of the SWR and relative power output.

To apply the following analysis to your

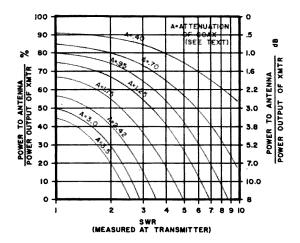


Fig. 1. Ratio of power at antenna to power at transmitter versus SWR.

antenna system, first compute the attenuation of your transmission line at the frequencies of interest when properly matched. This is done by looking up the attenuation per 100 feet of coax in **Table 1** or in the Radio Amateur's Handbook under Transmission Lines. Then:

With this information the % of the input power delivered to the antenna for a given SWR can be read directly from Fig. 1, for most antenna systems.

If a more exact answer is desired, use the formula

$$\frac{\text{Power to Antenna}}{\text{Power Output of}} = \frac{(S+1)^2 - K^2 (S-1)^2}{4KS}$$

Where S is the SWR indicated by the bridge and K is found by referring to Fig. 2.

The SWR should be measured close to the transmitter output connector for this analysis to be valid.

As a brief example, consider a station that has an 80 meter dipole fed with 50 feet of RG-58/U. Consulting Table 1, we find the attenuation at 80 meters to be 0.8 dB

per hundred feet and A =
$$\frac{.8 \times 50}{100}$$
 = .4

dB. If the SWR is 4:1, Fig. 1 shows that 81% of the transmitter output power is delivered to the antenna; that is, about 1 dB of power is lost in the feedline.

Consider a second example where the station is using the same feedline as above to feed a two meter beam. Let's say that the SWR measured on this band is only 2:1; this sounds like a more favorable situation than the one postulated in the first example. Once again, we refer to Table 1 and calculate A=3.5 db. Fig. 1 shows that only 22% of the power is delivered to the antenna.

Type of Coax	Attenuation per 100 ft. in dB						
RG-8/U. RG-9/U RG-10/U, RG-11/U	3.5 MHz .38	7.0 MHz .53	14 MHz .75	21 MHz .92	28 MHz 1.1	50 MHz 1.5	144 MHz 2.6
RG-58/U	.8	1.2	1.75	2.2	2.6	3.6	7.0

Table I—Attenuation of coax lines per hundred feet

If we use the equation given to do the same problem, we have

$$\frac{\text{Power to Antenna}}{\text{Power Output of}} = \frac{(3)^2 - (2.25)^2 (1)^2}{4(2) (2.25)} = \frac{9 - 5.06}{18} = .22$$

The value K=2.25 was read from Fig. 2. These examples show that there is no guesswork or magic associated with SWR, and much of the confusion on the subject is unwarranted.

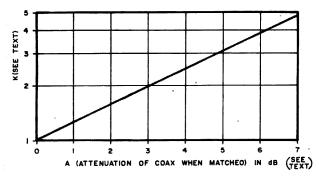


Fig. 2. Attenuation of coax versus factor K.

This analysis has some interesting results. For instance, if the antenna were disconnected from the feedline of example two, Fig. 1 shows that the SWR bridge would read an SWR of only 2.6; a deceptively low reading considering that all the power is being lost in the feedline,

On the other hand, the operator of the station postulated in example one would lose less than 3 dB of power with an SWR of 10:1!

The moral is, don't be fooled by guesswork and generalizations; compute the power you are losing at your installation on your favorite frequencies, and decide if you have an SWR problem.

One note of caution; high SWR's often make the transmitter difficult to load and excessive rf voltages may be created at high power levels. . . . K2DXO

- Stewart, John L., "Circuit Analysis of Transmission Lines," John Wiley and Sons, Inc., New York.
- Everett and Anner, "Communications Engineering," 3rd Edition, McGraw-Hill, New York.
- 3. The Radio Amateur's Handbook, ARRL. 4. Reference Data for Radio Engineers, 4th
- Reference Data for Radio Engineers, 4th Edition, ITT Corp.

Break-In for the HX-20

The VOX function for the Heathkit HX-20 transmitter may be used for CW break-in without making any changes in the transmitter's wiring. All that is needed is an audio signal from a CW monitor common to every CW man's shack. There are two simple ways that this may be accomplished. In the first method the microphone is simply hung beside the speaker of the monitor, the transmitter's audio gain control is set to the "CW" position, and the mode switch placed in either the "upper" or "lower" sideband position. For this the microphone element must remain open when the push-totalk switch is released. The author found it necessary to open his microphone and spring open the part of the push-to-talk switch that normally shorts the microphone element when the button is released.

An alternate method is similar except that a part of the audio signal from the monitor is fed through a .01 µF. capacitor and shielded cable to the microphone input (pin no. 1). A small outboard aluminum box equipped with a DPDT toggle switch and appropriate microphone fittings can be used to switch from c.w. to phone. No microphone tampering is necessary with this method.

As long as the transmitter's audio gain control remains in the "CW" position there is no signal distortion or 1000 Hz shift in frequency. The audio signal should not be taken from the receiver speaker since the transmitter anti-trip function will not allow the receiver audio to operate the VOX. The audio monitor must be one actuated by the station key rather than by the transmitter's rf output. (There will be no output until the vox has operated and turned on the transmitter).

. . . Arthur Gillespie W4VON

Mike Goldstein VEIADH 9 Edgehill Road Armdale (HFX), Nova Scotia Canada

Using Toroids In Ham Gear

More and more amateurs are using toroid coils in their construction projects — they offer high Q and excellent performance in a compact package. If you haven't tried toroids yet, VEIADH shows you how.

During the past few years, use of the toroid core in winding inductors and transformers has become increasingly popular. Once used primarily in telephone and teletype equipment, and some dc-dc converters, the toroid core can now be found in a great deal of contemporary solid-state electronics.

The advantages of using toroid cores are: high Q in a small size, a winding scarcely affected by external fields, and tight coupling of transformer windings. The disadvantages are that the ferrite cores are subject to temperature changes (more on this later) and a little inconvenient to mount on a chassis.

Since coils wound on toroid cores are insensitive to external fields (compare the permeability of ferrite with that of air!), it seems that the coil must be measured

Fig. I. A toroidal-core of six turns. When using toroids, there is no such thing as half a turn—if the wire goes through the center of the core, the turn counts as one full turn.

on an inductance bridge, since coupling to a grid-dip meter is not practical.

Toroid cores are available in sizes ranging from at least a foot to less than % inch in diameter. The basic material of the core is ferrite, a high-permeability material made up from several magnetic materials and a binder. It is important to note that there are many different grades of ferrite used in these cores, all with different electrical characteristics. To design around these cores, one must obtain manufacturers' data on the type of core at hand. If the cores obtained are unknown, (scrounged components don't always come with spec sheets!), grab some wire and head for the nearest inductance bridge. Some cores are good to 100 kHz, while others are used up to 50 MHz, so assume nothing.

There are several things one should keep in mind when using toroid cores:

1. For a loop of wire to be counted as a turn on a toroid core, the wire need only pass through the center of the core. Therefore, there is no such thing as a half-turn on a toroid core. Each time the wire passes through the core, a complete turn has been wound. If we remember that magnetic lines

of force tend to be self-completing, this is easily understood. Fig. 1 illustrates this concept of turns through the center. The coil shown in Fig. 1 is a six-turn coil, not a five-turn coil as it first appears to be.

2. Ferrite cores have a tendency to change their electrical characteristics with changes in temperature. One manufacturer states that for a selection of toroid cores popular in industrial rf work, the percent change in permeability per degree Centigrade varied from .01% to 0.5%, depending on core material. While this variation does not appear extreme, it means that oscillators using toroids in the frequency-determining circuits will drift, and sharp tuned circuits will drift out of resonance.

If it is necessary (or desirable) to use toroid cores as the core of a high-Q coil, and drift must be considered, one can use varactor diodes and/or temperature compensating capacitors to correct for drift. A much simpler solution is to use a much higher Q coil than is actually required, then pad the coil with resistance to decrease the Q to a desired value. The drift tendencies are padded by the resistance as well. The resistance may be put in series with the coil or in parallel with it. If I may delve into higher mathematics for a moment, the exact method of calculating the needed resistance will become clear. Considering the case of the series resistor first, let's assume that we require a 10 µH inductance with a Q of 10. As long as the coil we intend to pad has a much higher Q than the desired Q, we can ignore the coil resistance. Assume we measured our coil, and it measured 10 μH inductance with a Q of 50. What resistance do we put in series with the coil to decrease the Q to 10?

$$R_{\text{series}} \, = \, \frac{6.28 \text{ fL}}{Q}$$

where f = Operating frequency of coil in MHz.

L = Coil inductance in H.

Q = Desired Q of the finished coil

Substitute the proper values into the equation, grind out the answer and you have

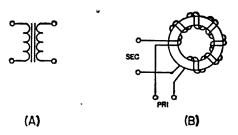


Fig. 2. Winding a high-frequency transformer on a toroid core.

the required value of series resistance.

Now, let's consider the case of a resistor in parallel with the coil. This will probably be the most popular case, as putting a resistor in series with a coil usually fouls up some dc circuit in the process. This might be a good place to mention that these parallel-tuned/padded circuits are dandy for broadband untuned circuits in transmitters, receivers, and converters. To design such a circuit, first determine the values of capacitance and inductance that resonate at the *center* of the band to be tuned. Then determine the necessary Q of the circuit:

$$Q = \frac{f}{B_w}$$

where f = Center frequency of desired band in MHz.

Bw = Width of the desired band in MHz.

Having found our desired Q, we need to know the parallel resistance across the coil to provide the desired Q.

$$R_{parallel} = 6.28 \text{ fLQ}$$

where f, L, and Q have the same values as the series resistance equation.

Perhaps I should point out that unpadded toroid-core circuits are dandy for high-Q, sharply tuned high-frequency circuits in receivers. Toroid cores are also very useful in constructing transformers for other high-frequency uses and for dc-dc converters.

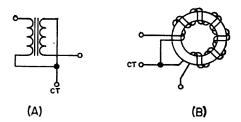


Fig. 3. A balanced, center-tapped inductor wound on a toroid core.

^{*}For the temperature range normally encountered in amateur equipment, particularly solid-state units, the drift contributed by the toroid core will usually be insignificant when compared to the other devices in the circuit. ed.

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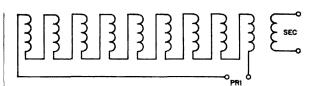


Fig. 4. Method of connecting several windings in series to obtain higher turns ratios. When doing this however, the proper phase relationships between windings must be observed.

The toroid core provides a means of obtaining a highly efficient, easily wound transformer.

They are efficient because of the very tight coupling between windings obtained by interwinding the transformer windings. For example, suppose we need a 1:1 transformer, with ten turns on the primary and secondary, for use at high frequencies. Choose a toroid core useable at the desired frequency. Parallel two wires long enough to wind ten turns on the core. Wind the ten turns and separate the leads. Secure the windings with some Q dope and voila—high-frequency transformer. The finished product is illustrated in Fig. 2.

If a balanced, center-tapped inductor is needed, wind it on a toroid exactly as the transformer of Fig. 2 was wound. After separating the leads, join the proper two leads to obtain the desired center-tapped inductor. See Fig. 3. Be careful to connect the proper leads (one from each end of the coil) to obtain the proper phase.

The method of winding shown in Fig. 2 and 3 is particularly useful if a multi-turn inductance or transformer is required. For example, suppose we require a transformer with ninety turns on the primary and ten turns on the secondary. Choose ten lengths of suitable wire long enough to wind ten turns on the core, and wind the ten turns as before. Separate one of the windings and call it the secondary. Now, separate the remaining windings and connect them all in series to obtain the ninety-turn primary. Be sure to observe the proper phase relationships when connecting the primary windings in series. See Fig. 4.

I am sure that many other uses will be dreamed up by amateurs for these cores, but these are a few of the more obvious ones. Most manufacturers will readily supply information for their products upon request. The cores may be cemented to a chassis with one of the epoxy cements.

. VE1ADH

Solid—State Alternator Regulator

An excellent regulator for the mobile operator. It will maintain the system voltage within $\frac{1}{3}$ volt even when drawing 150 amps — provided your alternator can take it!

The regulator described here was designed mainly for use with a 40- or 100-amp Leece-Neville alternator, but the circuit is compatible with just about any alternator made. If you are using the 100 amp unit, omit the current limiting pot and connect your bias wiring directly to the output of the regulator. (The 100-amp jobs have a tremendously low source resistance and current limiting protection is never required. However, fuses are advisable.) If you have a mechanical regulator, the best place for it is the round file. These gadgets offer poor regulation and always choose to fail when you're in Timbuktu.

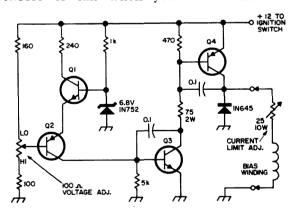


Fig. 1. Circuit diagram of the solid-state automotive voltage regulator. This circuit will provide excellent regulation to over 100 amperes. Although it was designed for use with Leece-Neville alternators, it will work with just about any alternator made. Transistor types may be chosen by referring to Table 1.

Moreover, it would cost twice as much for a mechanical unit which would do the same job as this transistorized unit.

In my car the regulator performs as follows: the system voltage from the alternator does not vary more than ½0 volt from 0 to 70 amps. From 70 to 120 amps the voltage drops a total of ¾ volt. At 150 amps out, the voltage is down only ¾ volt from the nominal setting. Running the alternator over 100 amps for a period exceeding 5 seconds is not recommended. The alternator will take it, but the rectifiers are not only expensive, they are cumbersome to replace!

Construction

I built my regulator on a sheet of fiberglass breadboard material. However, construction is not critical, so build it in or on anything you like. Make sure to heat sink Q_3 and Q_4 . Be sure the heatsinks are exposed to free air. Heat sink Q_3 as though it were to radiate 2 or 3 watts, and Q_4 10 to 20 watts, and you will be in good shape.

The circuit is designed so that you can use either germanium or silicon transistors anywhere in the circuit. Table 1 shows recommended transistors of both types. Transistors Q_3 and Q_4 will no doubt be the most expensive, so use germanium if the cost of silicon is prohibitive. Under no cir-

cumstances use germanium transistors, however, if you drive in an extremely hot climate or through deserts. Silicon transistors can withstand 2 to 4 times the temperature of a comparable germanium type.

Installation

Once constructed, install the regulator under the hood, preferably in front of the radiator so that it is cooled by virgin air rather than warmed air. On a hot day the temperature under the hood of a car is typically 200°F. Connect the output of the regulator (ground and the collector of Q_4) to the bias winding of your alternator. This winding is sometimes referred to as the "excitation coil". Time to connect 12 volts! Select a point that is turned on and off by the ignition switch, fused and easily capable of delivering 3 amps. Such a point is obtainable at the main fuse block in your car. Be sure to provide a good ground for the regulator.

Adjustment

Connect an accurate voltmeter across the battery. Throttle the engine up to about 1200 rpm and adjust the regulator for a system voltage of about 13.5 volts. If you are using the current limiter pot, be sure it is in the "shorted position" before making the above adjustment. There is nothing magic about the number 13.5; in fact, you should use the lowest value that will still maintain a good charged condition on your battery. After establishing the above potential, it is time to adjust the current limiter pot if you are using it. Turn on everything you normally use in the car: lights, ham rigs, etc., but do not exceed the maximum current you feel your particular alternator can safely deliver. Now, with the current limiter pot, adjust for a system potential of about 12.4 volts. Further current will now be drawn from the battery instead of the alternator.

Circuit Analysis

All high quality voltage regulators depend on a difference amplifier of some sort. In this case Q_1 and Q_2 serve the same purpose but are complementary; Q_3 and Q_4 further amplify and increase the open-loop gain of the regulator to an extremely high value. The alternator in the feedback path feeds back a value of $E_{\rm dc}$ to the voltage

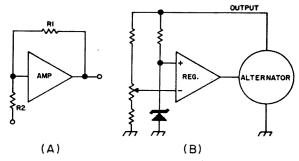


Fig. 2. Block diagram of the solid-state alternator. The system used closely resembles the simple dc feedback amplifier in A. In this type of amplifier, the gain closely approaches R_1/R_2 . If the gain is very high, the regulator in B will not allow the preset voltage to change until the alternator is no longer capable of delivering the required current.

divider in the regulator. Fig. 2 demonstrates how this system resembles a dc feedback amplifier. An ordinary feedback amplifier is also shown.

If the ratio of R_1 to R_2 is quite small compared to the open-loop gain of the amplifier (amplifier gain without feedback), then the gain will, in fact, nearly approach the ratio R₁/R₂. At this time one can appreciate the illustration in Fig. 2 and it should be evident that if the open-loop gain is tremendously high, the regulator (amplifier if you like) will not allow the preset voltage to change until such time that the alternator is no longer capable of delivering the required current. The .1 µF capacitors provide regulator stability since they apply local degeneration at a relatively high frequency. The 1N645 diode protects the output transistor when you shut off your ignition. This stops the large negative inductive surge which might conceivably achieve a value of 600 volts open-circuited. Any rectifier you have on hand that can handle an amp should do the job.

. . . K6UAW

Table I

Transis	tor Type	Silicon	Germanium
\mathbf{Q}_{i}	NPN	2N1711 1	None recommended*
Q_2	PNP	2N1132	None recommended*
\mathbf{Q}_{3}	NPN	2N657	None recommended*
	*	2N3738	
		2N3739	
Q,	PNP	2N3790	2N174, 2N1537,
		2N3789	2N3611, 2N3612

*No germanium transistors are suggested for Q_1 , Q_2 and Q_3 because excellent silicon units should cost less than \$6.00. If you use silicon all the way through, the cost should be less than \$13.00 total.

The Great Dipper

A versatile transistor emitter-dipper for the VHF man.

Test equipment is essential in the hamshack, as those of us have found when we attempted to get that new piece of homebrew perking for the first time. One of the most useful pieces of test equipment is the grid dip oscillator or simply, the GDO; besides being relatively inexpensive, it is particularly versatile. Need an indicating absorption wave meter? The GDO will do that. How about a modulated signal source? It handles that too. If you are interested in discovering its whole variety of uses, why not purchase one of several books on the subject.¹

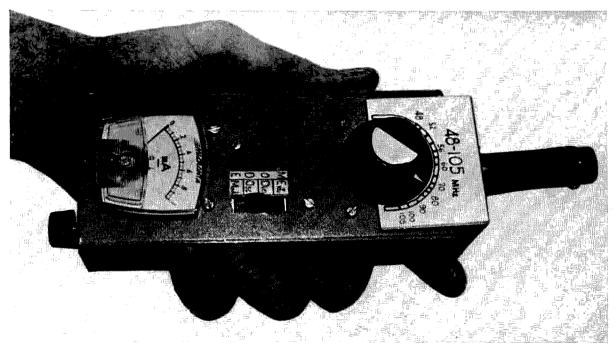
Every item used in this GDO was selected with an eye toward the average home builder. There are no parts which must be specially purchased from the West Indies Export Company or similar outfit. Nearly all the parts, except for the meter, miniature pot,

and mode switch, were obtained from the junkbox, or rather, from several junkboxes. If you insist on buying all new parts, total cost of the project will be about \$20.

Circuit description

The grid-dip oscillator, in this case more properly termed an emitter-dip oscillator, gets its name from the fact that emitter current in transistor Q_1 decreases when the tuned circuit C_1 - L_1 is in resonance with a nearby circuit. This decrease is easily seen by the dip of the meter indicating pointer.

When switched to the diode position, B+ is removed from the oscillator and the incoming rf is rectified by diode D_x ; the voltage developed across the 2k resistor is amplified by the meter amplifier and monitored by the 0-1 mA meter. In switching to the



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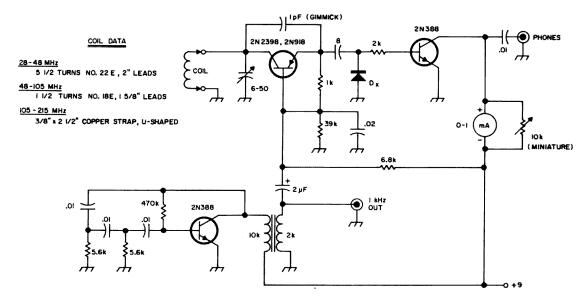


Fig. 1. Circuit diagram of the great dipper. Note that although the 2N2398 is a PNP transistor, the 2N918 is NPN, and if used as the oscillator transistor, problems would arise with voltage polarity. The diode D_x may be almost anything that you have available. The 1 pF gimmick capacitor consists of $1\frac{1}{2}$ " of twisted wire.

signal position, B+ is removed from the meter amplifier but applied to the modulator, and a 1 kHz tone is available from one of the output jacks. In the modulated oscillator position, B+ is reapplied to the oscillator, and the oscillator is modulated by the 1 kHz tone.

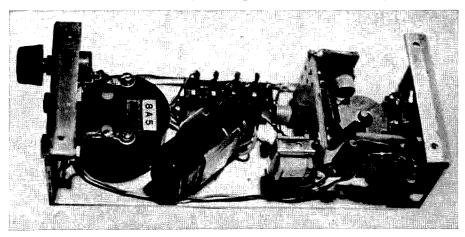
Like a patch-work quilt, this GDO was built using circuits from already published articles or books and modified where necessary. The whole circuit is composed of three separate entities—oscillator, meter amplifier, and audio tone generator. The circuit is not particularly critical, but lead lengths and dress in the oscillator must follow good VHF practice, if stable VHF oscillation is to be maintained.

My operating time is spent on the various bands from 28 mHz to 432 mHz. Quite naturally, when I discovered that the GDO would not oscillate satisfactorily over the entire range from 2 mHz to 200 mHz, I juggled values so that it would oscillate well at 216 mHz (for tuning frequency doublers to 432 mHz); then I tried to get as low in frequency as possible. Oscillation was vigorous to about 20 mHz. Coils and scales were then made to cover the respective ranges. It you don't do any homebrewing on the VHF bands perhaps you will find it necessary to change the value of the emitter-collector feedback capacitor, and to juggle the emitter and base resistor values in order to sustain oscillation at your desired frequencies.

Construction

Vector board was used, mainly because I wanted to experiment with component values; however, a printed circuit would be just as good, especially for something such as a

Internal construction of the great dipper. The modulator and oscillator boards are to the right—the oscillator transistor is mounted right next to the coil jacks.



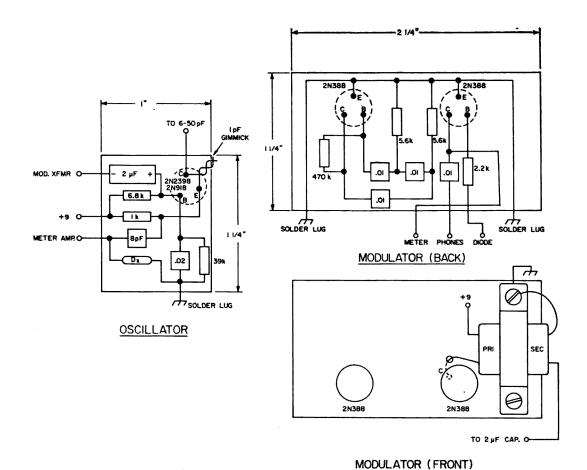


Fig. 2. Layout of the two circuit boards used in the great dipper. Although two boards were used in this case, the circuit could be easily adapted to one board, and even to printed circuitry.

club project. It can be seen from the photograph that the meter amplifier and audio oscillator are built on separate boards. This is due to the fact that I built several different amplifiers; the layout would look neater if they were on the same board. Positioning of the rf oscillator and capacitor C_1 as shown in the photograph is recommended, but the placement of other parts is not critical.

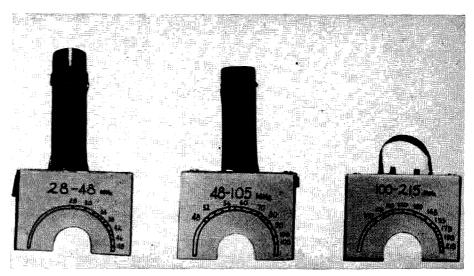
Fiberglass board is used as an insulator for mounting the banana jacks and plugs. It cuts and drills easily and appears to work fine. Three banana jacks were used, the third jack being used merely to provide mechanical rigidity. It could also be used, if necessary, to shunt additional capacitance across the emitter and collector on the lower frequencies.

Because a shear and a brake were available, I constructed my own chassis, consisting of two U-shaped pieces of ½6" aluminum. Using the GDO is a breeze, for it fits the hand very comfortably; if placed on the workbench, it doesn't roll off each time it is bumped. The completed case (1½" H x

2½" W x 6¼" L) is exceptionally rigid and imparts a reassuringly solid feel when handled. Commercially available miniboxes could be used if you don't have facilities available for rolling your own.

In building the rf oscillator, keep all the rf leads as short as possible; especially the short lead from C₁ to Q₁ and from circuit ground to chassis ground. It was found that false dips could be completely eliminated if a copper strap "" wide was added from the capacitor ground lug directly to chassis ground. Apparently the ground on the variable capacitor C1 is not quite good enough at frequencies above 100 mHz. Various transistors were tried in the oscillator; the PNP type 2N2398 was found to be a good performer, as was the NPN type 2N918. However, the use of the NPN type could lead to problems with battery polarity. Capacitor C2 is a 11/2" length of twisted wire positioned near the collector lead of Q_1 . This slightly modified oscillator circuit is from a book describing, among other things, a transistorized GDO which you may wish to use as a reference.2

The three plug-in coils for the Great Dipper. Three ranges cover from 28 to 216 MHz. The second harmonic of 216 MHz may be used for tuning up 432 MHz converters and such.



To keep cost low, a 0-1 mA meter was used in conjunction with a simple meter amplifier. If you happen to have a 0-50 μA meter lying in the junkbox, that would work equally well, and the circuit could be simplified accordingly. Several circuits were built for the meter amplifier; the one chosen was a compromise between cost and performance. A germanium transistor was used because it requires less voltage to turn it on. Leakage is low, the pointer of the meter resting just off zero when no coil is in place. Further information can be obtained from

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CASE

Fig. 3. Construction of the plug-in coil assemblies. The coil forms were made from the plastic containers which hold Polaroid print coater.

January 1966 73 Magazine, which was the source for this circuit.³

A transistorized audio tone generator is coupled by a 2 µF capacitor to the base of the oscillator transistor for modulation. This modulated oscillator allows the GDO to be used as a versatile signal source. An output jack is included on the panel to allow the 1 kHz tone to be used without turning on the oscillator. The deceivingly simple circuit was taken from June 1966 73 Magazine.⁴

There are a couple of components which not everyone will want to duplicate. One, the sub-miniature 10k pot with SPST switch, was chosen because a very limited amount of space was available; if the unit is built on a larger chassis, the more commonly available *Midgetrol* could be used. The other, a four position switch used to select the desired mode, is a 29c variety available from Lafayette or Radio Shack. It has a peculiar switching arrangement and if you duplicate this project, several hours of experimenting could be eliminated by following the pictorial diagram included in this article. A disadvantage of this particular switch is that

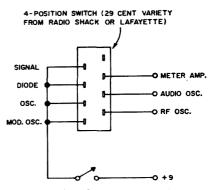
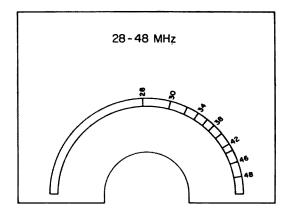
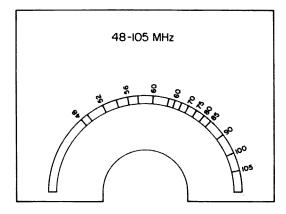


Fig. 4. Wiring the four-position slide switch for the great dipper.





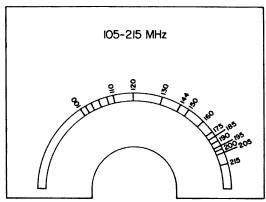


Fig. 5. Full-scale dials for the great dipper. If the construction shown in the photographs is followed closely, the calibration of these dials should be within several percent.

the meter does not indicate in the modulated oscillator position.

Using individual scales on each plug-in coil assembly greatly enhances scale legibility, reducing the chance of reading error and speeding frequency identification. This scheme, however, is not original. It was described in a 1957 issue of Short-wave Magazine, and is currently being used on a commercial GDO. It requires little additional effort to build the coil assembly in this manner and is, to me, well worth that extra effort. For want of anything else, the coil forms were made from the plastic tubes which contain the film coater supplied with each roll of Polaroid film.

Lastly, ease of tuning is accomplished largely through the use of a 1" skirted knob. Small knobs are simply too difficult to use comfortably.

Calibration and operation

It is best to calibrate this GDO by listening for the oscillator, modulated by the 1 kHz tone, on a general coverage receiver. An alternate method is to use another GDO, placing one in oscillate and the other in diode, tuning for either peak or dip. The scales which were used on this GDO will serve if parts and layout are followed closely.

To use this unit as a dipper, place the mode switch in oscillate, and place the dipper coil next to the coil under test. The turns of both coils should be parallel, and not at right angles to each other. To keep from pulling the oscillator frequency, keep the two coils separated as much as possible, while still maintaining a meter dip. This assures that dial accuracy will be kept high. If a coil is inaccessable, twist a pair of wires together, forming a two turn coil on each end; slip this coupling link over the two coils. Keep in mind that a coil, when it is in a circuit, may not dip at the same frequency as when it is out of this same circuit.

Conclusion

This is one of those pieces of test gear that makes you wonder, when you finally get one, how you ever got along without it. Not only is this GDO rugged and reliable, it is also inexpensive to build. The meter exhibits a deep positive dip and no false dips are evident. It has become indispensable to me. Some hours were spent optimizing values and layout for my particular needs, but the final result justified this effort. If you're skeptical, plug in the soldering iron and see for yourself!

. . . WAØAYP

References

- 1. How to Use Grid Dip Oscillators, by Rufus Turner, Howard W. Sams.
- 2. Practical Ham Radio Projects, by Charles Caringella, Howard W. Sams.
- 3. "Transistor Meter Amplifiers," WA6BSO, 73 Magazine, January 1966, p. 44. 4. "A Simple Two-Tone Test Generator," WA6BSO,
- 73 Magazine, June 1966, p. 42.

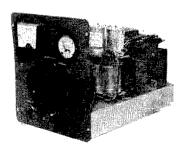
A 20—Amp Power Supply

Service your mobile gear with this inexpensive 20 amp supply built from surplus parts.

When I needed an inexpensive variable power supply for my mobile gear, I built this one with excellent results. I had previously found that commercially built supplies were either too costly or did not have the current requirements I needed. Construction of this supply centered around two ideas; keep it as simple and as inexpensive as possible while obtaining the highest power (my ARC-1 draws 15 amps without the autotune running). After looking around a little, I was able to get some high quality surplus parts very reasonably and this is the circuit I finally ended up with. While looking in the various electronic catalogues I found several components which would have been just as good except for price.

Because of the very nature of surplus here today, gone tomorrow—I doubt if the same parts I used can be easily obtained. They are included in the parts list merely as a guide. I have presented some alternatives here to save trouble for anyone wanting to build a similar unit.

Basically, the circuit consists of a high current, low voltage transformer with solid-state rectifiers and an inductive-capacitance "L" filter. Several refinements were added later to give the circuit shown in Fig. 1. A switch on the front panel (SI) provides up to I6 volts or up to 30 volts at 20 amps through a relay which changes the



The 20-amp power supply without its cover. In the photo the capacitors and two chokes can be seen in the rear.

windings on the secondary of the power transformer. Meters showing voltage and current are provided and the voltage is varied by means of a small variable transformer mounted on the front panel.

The main component of this type of power supply is, of course, the power transformer. I obtained mine from John Meshna¹ for \$4.50. The secondary consists of four 9-volt windings at ten amps each. Filter chokes T2 and T3 are both ten amps, also from Meshna for about a dollar each; or, a 50-amp monster weighing 22 pounds is available from Barry's² for \$22.00. I used the others mainly because I had them in my junk box.

If you can't get a transformer like mine, the companion to the above choke is listed in Barry's catalogue at \$27.00. It has only one winding and is rated at 24 Vac, 50 amps. This would be an excellent choice if you are willing to spend the extra money. You could almost arc weld with it! If you don't need that much power and want to spend less, Barry's has several different high current transformers and chokes listed from five to ten dollars.

The diodes, meters, switches and output connectors can be found almost anywhere. I had mine just lying around. The 0-30 ampere meter is for a car and was purchased for a dollar from the Surplus Center in Lincoln, Nebraska. The variable transformer is a small two-amp unit which came out of a piece of fire-control equipment and varies the voltage on the primary of the power transformer. I already had the cabinet.

I used two I000 µF, 25 volt capacitors in series at first, hoping they would work, but found my ripple was too high with T2 and T3 at .037 henries. I had several of these capacitors on hand and proceeded to stuff them in the cabinet wired in seriesparallel until I had sixteen totalling 8000

¹Meshna, 19 Allerton Street, Lynn, Mass. 01904.

²Barry Electronics, 512 Broadway, New York, New York 10012.

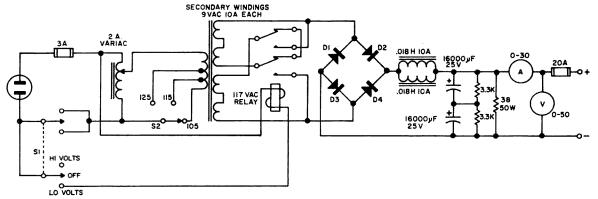
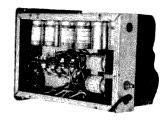


Fig. 1. Schematic of the 20-amp power supply. The 1600 μF filter capacitors consist of sixteen 1000 μF units wired in parallel. A minimum of 8000 μF should be used. The diodes are 100 PIV, 20-amp units available from Meshna.

 μF . Not very professional, but quite effective. Two 8000 μF units at 55 volts each from Barry's for \$2.50 apiece would work even better in parallel. If you use odd values in series be sure to shunt them with a 3.3k, ½ watt, resistor or at least 100 ohms per volt of supply voltage to equalize the voltage drop across the capacitors.

Construction is straightforward and wiring noncritical. The front panel should be attached to the chassis first and then the switch and pilot light holes drilled. Locate the rest of the parts on the chassis and "fit" them, then drill the holes. If a variable transformer with an external wiper arm is used, make sure there is clearance with the arm in all positions. Control wiringswitch contacts, variable transformer winding leads, pilot light terminals-is made with regular solid hookup wire, but use heavy wire for all current carrying leads. I used stranded number 14 wire for easier handling. Manipulating the power transformer's solid leads proved to be very difficult. If you get a transformer like mine, any heavy duty relay can be used to switch the secondaries. A pilot light enables me to tell when I am in the low-range position. It is connected across K1 and lights when



Bottom view of the 20-amp power supply showing the layout of the bottom bank of capacitors and 20amp diodes. Since no heat sink was available at the time of construction, rubber grommets were used to insulate the diodes from the home-made bracket. the relay is energized. The diodes run cool mounted to the chassis with no heat sink.

The diodes are rated at 20 amps each, although I seldom have more than ten-amp loads on the supply. A circuit breaker should be included in series with the output to prevent damage to the diodes and other components because the fuse in the primary of the transformer will not act fast enough.

With the power supply in operation, regulation is poor because of the charge of the capacitors. However, the variable transformer can be adjusted to compensate for different loads. On-off switch SI is a DPDT type with a center off position. In the lowrange position, with the toggle pointing downward, the relay kicks in to place the transformer windings in parallel. In the highrange position, the toggle is up and the relay is not energized. Because of the instant on feature, the switch should be wired this way to prevent accidentally placing a higher voltage on units under test. To turn on a piece of equipment, the operator will instinctively push the switch down to get a low range voltage.

I have been using this supply for servicing transistor radios and running my mobile equipment and unconverted 28-volt surplus gear for over a year with no trouble. I even charge batteries with it at times. Surplus parts are used throughout except for the two pilot lights, and from the use I get out of it, the parts have proved to be the best deals I ever made. This under-twenty-dollar 20 amp supply would probably sell for well over a hundred dollars retail! So, if you are short on cash and high on amps, try this one. It's a shame to let all those high quality parts go to waste.

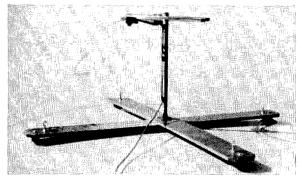
. . . WA4SAM

X Marks the Spot

Did you ever consider trying some mobile operation, only to drop the idea like a hot 813 for fear of marring your car with a permanent antenna installation? Worry no longer, for here is a temporary antenna mount which in no way harms the vehicle it is fastened to, and yet is as strong as any bumper-mount.

The X-mount was born of necessity; I wanted to share in the fun of mobile operation, and yet, there were orders that no holes of any type could be drilled in the family car. A search for a commercial bumpermount revealed the recessed bumper on the 1961 Valiant to be a tough customer. I only found one mount which would hold the mast clear of the over-hanging rear, and it was so flimsy that it couldn't be considered. I really didn't want to use a bumper-mount anyway, because they are too permanent. This is a distinct advantage when Friday night comes. Women, young and old, share an aversion to being seen in an automobile that looks like it belonged on the set for "Highway Patrol."

Several tests of gutter-mounted verticals were made, but they were so susceptible to ignition interference from other vehicles that they were ruled out. Also, the majority of the



The X-mount is slid around on the roof of the car until it is centered, then the straps are put in place. In this picture the mount is being used to support a commercial two-meter halo antenna.

2-meter stations in the Washington, D.C. area are horizontally polarized. A halo or big wheel seemed to be the best antenna for my purpose, but how to mount it?

Just when I thought that I was destined to drive around holding a halo out the window, the great antenna search was ended. Dad, WA3DRI, had designed an antenna mount that seemed to have everything that was required. It was sturdy yet easily installed, and did not harm the car. Besides, this was the only antenna which WA3DRI would allow to be used on his car—the one he designed of course. The X-mount, so named because of its shape, provides a solid mount for VHF antennas.

The cross-pieces of the original were cut from ½ inch plywood. They were 4½ inches wide by 48 inches long, but could be made smaller. The prototype turned out to be much stronger than we had thought it would be. Three good coats of varnish sealed the plywood from the weather, but those who worry about such things might paint the mount to match their car.

The suction cups are replacements for cartop carriers and are easily obtained through the popular mail-order stores. We mounted ours by simply screwing them to a jam-fit with machine screws.

Due to a lack of originality and a surplus of screw-eyes, we secured our mount to the car with webbed straps and gutter-clips. The straps, with the clips attached, are simply looped over the screw-eyes.

Four bolts hold the cross-arms at their intersection. At this point a faceplate pipe fitting was mounted. The antenna mast consists of a length of pipe which is threaded so that it screws into the flange.

Although the X-mount was designed as a mount for VHF antennas, there is no reason why it couldn't be adapted to support high-frequency verticals, particularly those shortened by a loading coil. There is no limit

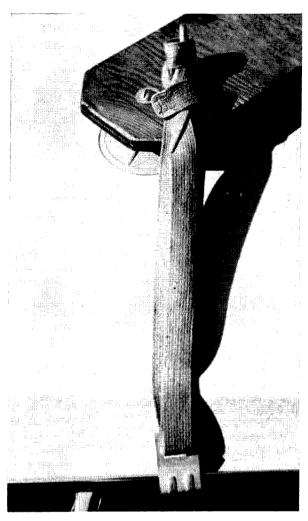
to the length of mast which could be tolerated on a parked car during portable operations.

Much discussion developed concerning the height above the car roof at which the two-meter halo should be mounted. Some books said ¼ wave length, and some hams said that this would make a good vertical beam with the car's roof acting as a reflector. Nice for talking to aircraft, but not too practical for conventional use.

Accepting no one's word, we tested different heights from one inch to four feet above the roof. The antenna was observed to radiate the strongest field when it was 19 inches or ¼ wave length above the roof. Adding extra height up to four feet did not improve the signal.

This would indicate that a six-meter halo should be mounted 52 inches above the roof, a little high for a rigidly mounted antenna. The antenna would probably load satisfactorily even if it were lower. After all, how many bumper-mounted six-meter halos are 52 inches above the trunk?

Hopefully, we have given you some ideas for a quick and dirty mobile set-up. Don't miss out on the fun of mobiling because you think that your car must be torn up to mount the antenna. By the way, if you do build a mount similar to ours, be prepared for such comments as: "Doesn't watching television interfere with your driving?" and "Where's the moose that rack came from?" WA3AID



The X-mount is secured to the car with suction cups, gutter clips and straps as shown here.

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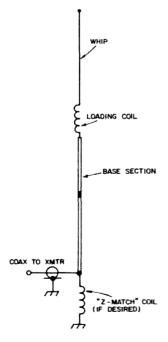


Russ Alexander W6IEL 2890 San Francisco Avenue Long Beach, California 90806

Go-Go-Mobile

40, 20, 25 and 10 for under \$10.

If you've had the urge to go mobile at the least possible cost—particularly regarding the mobile antenna—here's a good, inexpensive way to do it. All the parts are easy to obtain, construction is simple and quick, and a highly effective antenna is the result. The "Hi-Q" coil arrangement has been found very effective, and on field tests, the performance of this unit exceeded that of two popular commercial antennas. Comparative S-meter reports at several hundred miles' distance showed one full S-unit higher, and



Hooking up the Go-Go Mobile antenna with a Z-match.



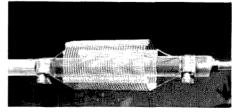
local field strength measurements showed appreciable gain over the commercial units.

The base section is electrical-mechanical tubing (EMT, which is light, strong, and attractive). The top whip is a walkie-talkie, CB replacement unit, or a standard auto radio item—whichever is preferred. With their sliding sections, these units give smooth and rapid adjustment to your exact transmitting frequency.

The unit illustrated here covers 40, 20, 15 and 10 meters by tapping the coil and adjusting the height of the top whip section.

Construction is begun by fitting a plastic or maple rod into the EMT base section tubing and securing it with a self-tapping screw through the tubing into the plastic rod. The next step is to mount the whip by tapping into the top of the plastic rod with the same screw-thread size as provided on the bottom of the whip.

The loading coil is supported on the plastic rod by three wires, top and bottom, soldered 120° apart, on the coil turns at each end of the coil. These wires are then bent toward the plastic rod and clamped in place by the worm-drive hose clamps. One



The loading coil. Note the support wires, which are connected from the first and last turns of the airwound coil.

Table 1.

Contacts made during final test of mobile antenna project.

Band	Call	ф т н	Signal Report		
40	W6VX	Brentwood, California	10 over S-9		
40	WA6FQI	Fullerton, California	Wants antenna data		
40	WB6SEC	Bakersfield, California	Q5-S-15		
20	WA7BKW	Billings, Montana	Plus S-12		
15	W5PLE	Houston, Texas	"Exceptional Mobile Signal"		
10	W6NRV	Fullerton, California	Q-5		
10	WB6HVS	Garden Grove, California	Excellent Signal for "Ground Wave"		
10	KH6EEM	Honolulu, Hawaii	Q5-S8		
10	W4QKK	Winter Park, Florida Q5-S10 plus			
10	WA4WFE	Winter Park, Florida	Q5-S-10		
10	W9ELG	Chicago, Illinois	"Terrific Signal"		

Note: These contacts were made from the driveway at my home with a Drake TR-4 Transceiver. The SWR was less than 1.5:1 on all bands.

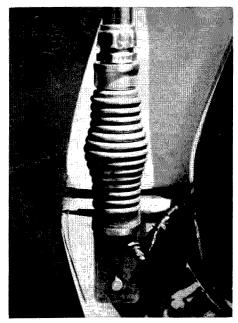
of the three wires on each end of the coil should be extended to provide electrical connection to the base section on the bottom and to the whip section on the top.

The pipe cap on the base section is drilled with a %" hole and a %"-24 threaded cap screw is inserted and soldered in place. This is best done over a gas flame, flooding plenty of solder over and around the head of the previously well-cleaned cap screw. Then the EMT base section is fitted with an EMT compression fitting, which is then screwed tightly into the %" pipe cap.

The antenna is now ready for installation -run 52-ohm coax between the transmitter and the antenna base, making certain that the coax braid is well grounded. The antenna must now be tuned to your operating frequency; this is best done with an SWR meter and test clips, tapping down a turn at a time until the lowest SWR is obtained. Coarse adjustment may be made with a GDO, if available, followed up with fine adjustments obtained by changing the length of the top whip in increments of 1/2" or so. The overall length of the top whip should then be measured for future reference when making an appreciable frequency change within the band in use. After setting the top whip for the correct length for the operating frequency, the sliding section can be easily locked in place with a single wrapping of transparent Scotch tape.

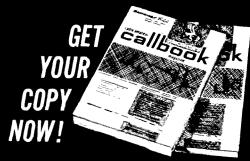
On the antenna illustrated, the 40-meter phone band required all but two of the coil turns, and the top whip was extended to 47½ inches; on the 20-meter band, the coil was tapped down to 10 turns; for 15-meters, 5 turns. For operation on 10 meters, the coil is completely shunted and resonant frequency adjustments are made entirely by adjusting the top whip section. In order to minimize the amount of dielectric in the field of the coil, no cover was used, thereby retaining the highest "Q" and efficiency.

If a spring mount is used with this antenna, a fish line is used to stabilize it and to minimize swaying while under way. Tie the line between the car and the underside of



Construction of the base section of the W6IEL mobile antenna.

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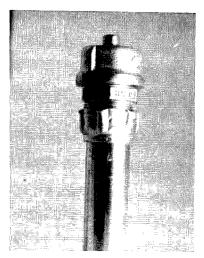
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Base mounting of the mobile antenna, showing the use of a threaded pipe cap.

Mobile Antenna Parts List

Loading Coil-

34 turns, 21/2" diameter, 8 turns per inch, Air Dux #2008T. Illumitronic Engineering, Sunnyvale, California.

Coil Support-

10" x 1" diameter solid polystyrene or lucite rod. If plastic is not available use hard maple dowel; wax thoroughly before mounting.

Two worm-drive hose clamps.

Top Whip-

CB replacement antenna or replacement auto whip, 50" extended, 11 section, Olson #AA-148, Olson Electronics, 260 Forge Street, Akron, Ohio, 44308.

Base Section-

52" of 34" diameter electrical metallic tubing (Thinwall conduit—EMT)

I—¾" EMPT connector—Compression type (T & B #5221 or Appleton #96T075)

1-34" Brass pipe cap

I—¾" x 24 THD cap screw

I Bumper mount, Allied #86U606

the coil support.

If you haven't gone mobile before, you'll be surprised and delighted at the additional pleasure to be obtained from ham radio and the amazing DX that can be worked using an efficient, center-loading mobile antenna.

... W6IEL

The Front-to-Back Ratio of an Automobile

Have you ever checked the antenna pattern of your mobile antenna?

We are, of course, accustomed to thinking in terms of the back-to-front ratio of beams, but how about the directional properties of the automobile in mobile operation?

Some time ago I did some work on this subject with a view to learning something about the effect of different positions for an antenna on a car.

My first experiments were carried out on a station wagon with a nearly flat metal

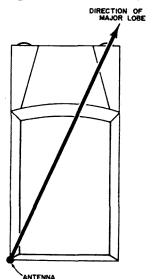


Fig. 1. Directional pattern of a vertical mounted in the rear left corner of a station wagon.

roof. I deliberately placed the antenna base on a bracket mounted at the left hand rear corner of the roof.

I soon found that the major lobe was in the direction diagonally across the roof of the car as shown in Fig. 1. Thus it appeared that the roof was acting as one part of a dipole (see Fig. 2) rather than as a ground plane.

On 10 metres this was very logical since the diagonal length of the roof of the car was roughly ¼ wave length on 10 metres.

On 15 and 20 metres a similar radiation pattern was found although, of course, the roof of the car was too short for ¼ wave length on 20 metres. Probably the SWR was quite high but I never measured this, because owing to the very short feeder used in mobile installations I do not regard the SWR as very important. Provided the SWR is not so bad as to prevent the antenna loading, the actual SWR is felt to be of little importance. The losses on that length of feeder are small.

For some time I continued to use my mobile installation with the antenna placed unsymmetrically in this way and found a back to front ratio of about 3 dB on 10, 15 and 20 metres. This small beam effect was at first welcomed as it facilitated mak-

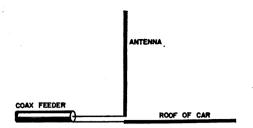


Fig. 2. Apparent effective antenna on 10 meters with the arrangement in Fig. 1.

ing contacts when the car was stationary.

Soon, however, the disadvantages became apparent. When in motion, particularly when driving in towns where frequent turns are necessary, this beam effect tended to increase the QSB always present in mobile operation. This was a distinct disadvantage.

So a second bracket was fitted in the centre of one side of the roof. See Fig. 3.

It may be asked why I did not mount the antenna in the middle of the roof. There were two reasons.

- (1) I felt that to pierce the roof might lead to rain coming through the roof. It would need a good professional job to do this effectively.
- (2) It would be difficult to reach the antenna to adjust it to take it down.

Thus I tried it in the two positions shown in Fig. 3.

The effect of position two was about as expected—a somewhat cardoid pattern developed, as in Fig. 4.

In other words the antenna radiated best in those directions in which there was longest line of roof and least well where there was no roof at all. For operation in motion there was an advantage, though to some extent I lost the beam effect when stationary, that is I could no longer get as much advantage from aiming the car towards the other station as I could before.

Recently I fitted a mobile rig into another car. This is a convertible and so no metal roof was available. I decided to mount the antenna as symmetrically as possible and chose the centre of the panel between the back of the roof and the hinge of the trunk, as in Fig. 5. Here I got a professional body builder to seal the hole against rain, etc.

I took great trouble also on this occasion to bond all parts of the metalwork of the car together. I bonded the trunk lid to the body, the doors to the body (I do not regard the

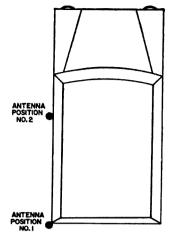


Fig. 3. The second location for the antenna is shown above.

door hinges as adequate contact) the body to the chassis, the engine to the chassis, the hood lid to the body, etc. etc.

The results on the new car have been very satisfactory, much DX has been worked, all continents and a number of new countries added to my MCA award (Mobile Century Award) including BV1US.

Recently I was able to take a polar diagram (Fig. 6) by rotating the car while getting readings from a station about 60 miles away on 15 metres (presumably ground wave).

I was quite surprised to see how directional the car still was despite my efforts to put the antenna as nearly centrally as possible in a convertible.

I have not mentioned the vertical posi-

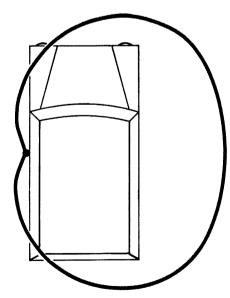
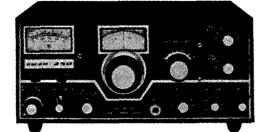


Fig. 4. Pattern of the antenna in position two in Fig. 3.

6 METER TRANSCEIVER

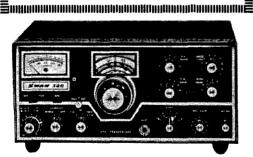


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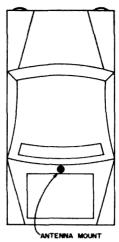


Fig. 5. Antenna mounted in the convertible.

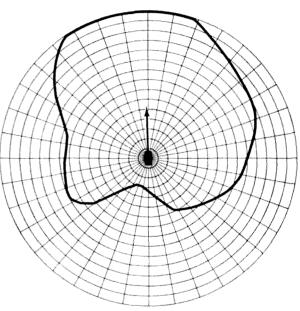


Fig. 6. Directional pattern of the antenna as mounted in Fig. 5.

tion of the antenna so far. In the first two examples, the antenna was mounted at roof level and in the second case as high as possible bearing in mind that there is no fixed roof.

Many people fix their antennas to the bumper. But I believe that the higher the antenna is placed, provided a good massive metal base is under it, the better.

No claim is made that this polar diagram is conclusive, since, in my opinion, far more experimentation is needed and this polar diagram is based on one test only.

I hope that this discussion will stimulate interest in mobile antennas and their positioning from the efficiency rather than the aesthetic point of view.

. . . G3BID



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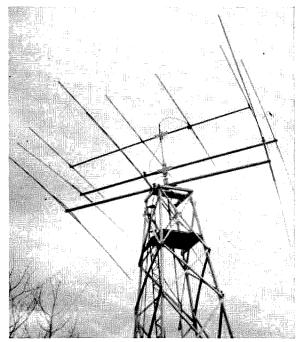
Geerge Cousins VEITG Box 18, RR 2 Lower Sackville, Nova Scotia Canada

Beginner's Beam for 10 Meters

The ten meter openings are going to be better this winter than they were last—this simple, low-cost four element beam will increase the effectiveness of your signal.

With the steady improvement in 10 meter propagation conditions, it looks like DX prospects will be pretty bright by the winter of 1967/68, and many old-timers will be dusting off their beams and looking forward to a return of the "good old days". However, there are a great many newcomers to the ranks of ham radio who are inexperienced on this band, and this article is really intended for them.

Most people will argue that the power output of the rig is the least important fac-



The antennas at VEITG—the four-element ten-meter beam is on top with homebrew 15 and 20 meter beams on the bottom. The tower is also home built.

tor in 10 meter DX operation. Naturally a kilowatt will make a big noise, but a 100-200 watt rig will make just as much noise if it's hooked onto a good antenna. The size and weight of 10 meter beams are well within reason for even the most crowded back yard or roof-top.

The beam described here is ideal, especially for the newcomer, as it combines light weight, standard components, very simple construction, and of course, low cost. Despite the simplicity, the gain will be 7 to 8 dB for the three-element version, and around 9 or 10 dB for the four element one. For the small extra cost and work involved, the four element version is much to be preferred. The front-to-back ratio will also be better, and the extra gain is worthwhile.

Depending upon your operating preferences, the length of the elements should be decided by reference to the standard formulae:

Driven element length =
$$\frac{473}{\text{Freq MHz}}$$

Reflector length =
$$\frac{501}{\text{Freq. MHz}}$$

Director length (both) =
$$\frac{450}{\text{Freq. MHz}}$$

Since the elements are adjustable, the exact lengths are easy to come by. If the

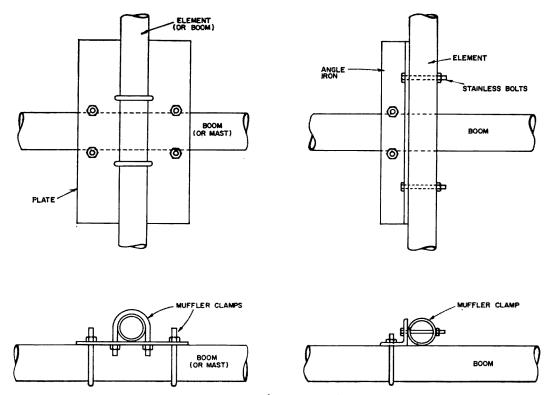


Fig. 1. Alternate methods for mounting the beam elements on the boom.

material is purchased new, choose rigid aluminum tubing 1" and %" in diameter (or similar relationships in size) so that the center sections can be made of the larger tubing with the smaller tubing inserted into the ends to form the adjustable sections. For a 4-element beam, you'll need four lengths of the larger size, and three lengths of the smaller. This is assuming you get 12-13 foot lengths which are pretty well standard. The three lengths of smaller tubing can be cut into four foot pieces for the end sections, with a little left over. If cost is a prime factor, you can use old booms from defunct TV antennae as I did. I scrounged a bunch of these from a local service shop, took off all the elements and assorted junk, and ended up with excellent material for the beam elements.

Without doubt, the best material for the boom is old reliable irrigation tubing. The 2" diameter stuff is fine, in a 20 foot length. This gives reasonably wide element spacing. As a matter of fact, a 5-element beam can be mounted on such a boom if you wish, but I happen to prefer the wider spacing. Steel TV masting is another common material which can be used for the boom, but it is quite a bit heavier and you may have to couple sections together to make up the re-

quired length.

Several methods can be used to mount the elements on the boom, as shown in Fig. 1. In both cases, standard automobile muffler clamps are used to fasten the element support plates to the boom. Make sure the clamps are given a couple of coats of rust-proofing first. By using the flat plates, the elements can be laid across the long di-

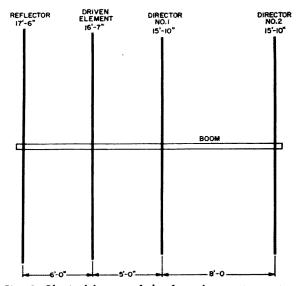


Fig. 2. Physical layout of the four-element ten-meter beam. Dimensions given are for approximately 28.4 MHz.



Fig. 3. Construction of a typical element, showing the adjustable end sections.

mension of the plate and fastened with small U-bolts. On my own model I used angle iron instead and fastened the elements onto the iron with *stainless* steel bolts. Be sure you use nothing but rust-proof hardware on the beam. There isn't much required, and the small cost is well worthwhile if and when you try to take it apart again.

Fig. 2 shows the arrangement of the elements on the boom and the spacings used. Antenna handbooks give all sorts of opinions on which spacing is best, and why, but as a general rule the optimum spacing should be 0.2, 0.2 and 0.25 wavelength, reading from the reflector to the second director. I modified this a bit in an effort to get a higher front-to-back ratio, so feel free to change the spacing if you wish.

Fig. 3 shows a typical element and how it is put together. Simple. All you need is a hacksaw, a screwdriver and two hose clamps per element. Depending upon how the tubing fits, you may need small shims to tighten up the joints. Incidentally, if aluminum tubing is not readily available, look up the nearest electrical contractor and his stock of thinwall conduit, either steel or aluminum. This comes in all diameters, but unfortunately the standard length is only 10 feet, so your total requirements will be a little different.

The boom-to-mast clamping arrangement shown in Fig. 4 is probably in its simplest possible form. Two pieces of flat steel or iron and four muffler clamps—with a couple of coats of paint—will do the job very nicely.

With the whole beam assembled, the last problem is tuning. Since the majority of rigs today use coaxial outputs, the easiest method of feeding the antenna is with 52 ohm coax

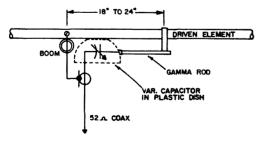


Fig. 4. Gamma match details for the four-element ten-meter beam.

and a gamma match. This is diagrammed in Fig. 5 and uses a small variable capacitor mounted in a plastic refrigerator dish or similar weatherproof container. Use a fairly widespaced capacitor, not because of power handling requirements, but to prevent oxidation from shorting out the plates. The gamma rod is tapped onto the driven element at a trial position and the SWR is measured on the transmission line. Use as little power as possible for this adjustment procedure in order to reduce QRM. Carefully rotate the capacitor through its range and try to reduce the SWR as close to 1:1 as possible. It may be necessary to change the position of the tap several times, but usually the capacitor will do the trick after one or two trials. For this procedure the beam should be mounted reasonably well off the ground and away from trees, guy wires, etc. The ideal place for it is on top of your tower, but this may not be possible. The procedure will be infinitely easier if you can persuade someone to turn the capacitor while you watch the SWR meter and the resonance of the final in the rig. It changes considerably while all this is going on, so make sure you check it often. Actually, if you get the SWR down under 1.5 you can be pretty happy with it. It is debatable whether or not the extra effort of getting down to 1:1 is worthwhile.

The last problem is tuning the elements for best forward gain-or best F/B ratio. The two factors don't go hand-in-hand. Several methods can be used, all of which involve test dipoles, field strength meters, signals which stay steady enough to make adjustments and of course, the "friendly amateur" "a few miles away" who will dutifully do just what you want him to-baloney! If you figure out your dimensions properly by formulae, measure the lengths exactly, and get the gamma match adjusted, you are very likely going to get just as much out of the antenna as if you spend a month fooling with it. It's your choice—the methods are detailed in the various handbooks. Personally I don't think it's worth the effort.

The tower and rotating system are up to the individual. However, the light weight construction should allow the use of a TV type tower and rotator. This beam will give the low or medium power operator many hours of fine contacts and provides a *kilowatt* type signal at a small fraction of the cost. Welcome to 10 meters.

. . . VE1TG

Simplified Printed Circuits

Current interest in transistorized construction projects is high; prices of many types of transistors are much lower than equivalent tubes. Many of the current construction articles include a printed circuit layout and this makes things more interesting and much easier.

I have etched several of these circuits with success and have even done the layout myself on a few of them. I use the photographic method, as it is much easier and one can produce several circuits from one negative if necessary (for club projects and such).

First, you need the photo-sensitive (presensitized) copper-clad boards. I use onesided glass base, obtained from B-A* for about 75c each in the 3" x 6" size. They come in light-tight packages, so don't expose them to flourescent lights or direct sunlight; low wattage incandescent bulbs can be used to work by. You will also need a contactprinting frame, which is nothing more than a sheet of glass placed over a flat sheet of foam rubber and can be as fancy or plain as you wish. Just be sure the negative is absolutely flat when put it in the frame; use clamps or weight on edges of glass. The board to be etched is placed face up on the foam rubber, the negative is placed on top of the board, and the whole works is exposed. For exposure lamps I use a couple of R40 sun lamps in a Kodak bracket and expose for 16 minutes.

The negatives I use are paper negatives produced on a Verifax copying machine. These are the *Fine Line* one time matrices; use a soft, damp sponge to remove any color from the white areas. Careful, don't scratch! If you know of a printing shop using offset printing you can probably get them to shoot a whole batch for a couple of bucks or so. These will be film negatives and will require about a third less exposure than the Verifax Negatives.

*Burstein-Appleby, 1012 McGee Street, Kansas City, Missouri 64106.

After the exposure, the board is placed face up in an aluminum pan or dish and trichlorethylene is gently poured into the container so as to cover the board. Do not disturb the copper surface; at this stage it is very soft. Rock the container gently for a minute or so, then carefully remove and let dry. Drying only takes about 30 seconds, so don't blow or heat, just let it air dry. When completely dry, place the board face up in a plastic container, such as the larger ones that disc capacitors come in. Gently flow ferrous chloride solution into the container and start etching. This takes from 20 minutes to an hour, depending upon the temperature of the solution. I use an old hair dryer a couple of inches above the surface of the solution to speed things up a bit. Check on the etching frequently and when the unwanted parts of the copper are completely etched away, drain and wash in running water for a couple of minutes.

These chemicals are perfactly safe, just don't spill any ferrous chloride because it stains quite badly. Dump it carefully and flush with plenty of water. Trichlorethylene was obtained from a local chemical company (\$1.00 a gallon) and the ferrous chloride was scrounged from a local photo-engraver.

In making the originals I use pen and ink and *Chart-Pak* tapes. The Chart-Pak tapes are rolls of black paper tape in various widths and are available from most office supply houses. The dots and connectors are usually furnished with the board kits. These are gummed on the reverse side and save a lot of time-consuming hand-drawn circuits.

To date, I have etched the Multical (five at a time), the Two-Tone Test Oscillator, Regulated Power Supply, Grid Dip Oscillator, FET Voltmeter, 6 Meter Converter and several others in fine shape. Why not get a fist full of inexpensive transistors and have a ball with etched circuitry?

. . . K5IRP

Designing Transistor Oscillators

If you have been having trouble with transistor oscillators, this article will show you how to design them to meet your requirements. Five brand new nomographs eliminate most of the math.

Of all the electronic circuits that the ham must analyze, design, construct and use, oscillators are apt to give him the most trouble. Although oscillators are basic requirements for any radio communications, they are probably cussed at more and understood less than any other singular circuit. Actually, vacuum tube (and FET) oscillators are relatively easy to get going, and except for some thermal drift problems, are fairly simple to tame down. In vacuum tube circuits, you can hang just about any tuned circuit across the output, feed a little of the output energy back to the grid, and the thing will take off. It really doesn't seem to matter a great deal what the tuned circuit values are so long as they are resonant at the desired frequency. It's this last statement that gets most oscillator builders into trouble. Even though in many cases it doesn't seem to matter what the tunedcircuit values are, in almost every instance it does, and frequency stability, amplitude stability, and power output can be improved by pursuing proper design.

With the transistor oscillator, it's a little different story; this is because the low value of input impedance associated with a transistor may seriously load the oscillator circuit if it is not properly designed. In fact, if the tuned circuit is not properly designed, chances are the circuit won't oscillate at all. It is the purpose of this article to describe some of the more common transistor oscilla-

tor circuits and to present a simplified method for their design.

Although all oscillator circuits consist of an active device such as a transistor, and some passive elements like capacitors and coils to store energy, there are actually two basic categories of oscillators, *harmonic* and relaxation.

In the harmonic oscillator, energy always flows in one direction from the transistor to the tuned circuit, and the frequency of oscillation is determined by the frequency characteristics of the feedback path. In the relaxation oscillator the transistor acts like a largesignal switch which periodically turns on and cuts off the flow of dc power to the passive storage elements in the circuit; its frequency is determined by the charge and discharge time during the exchange of energy. This type of oscillator is normally characterized by a nonsinusoidal output, while the harmonic oscillator primarily produces a sine wave and is of major importance in all radio equipment. Only the harmonic oscillator will be discussed in this article.

Depending upon what frequency selection components are used in the circuit, the output waveform may or may not show in what way it was generated. One important characteristic of the harmonic oscillator is that the transistor is continually applying power to the tuned circuit; in the relaxation oscillator there is an interchange of energy in a discontinuous manner.

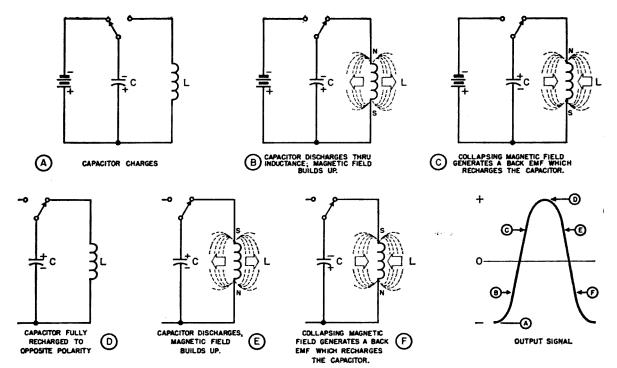


Fig. 1. Oscillatory action in a simple resonant LC circuit.

Basic oscillator circuit

Before we discuss transistor harmonic oscillators in detail, let's talk a little about the most simple oscillatory circuit of all, the straight-forward L-C circuit illustrated in Fig. 1. If the capacitor in the tank circuit is initially charged with a battery (Fig. 1A), and then switched in parallel with an inductor (Fig. 1B), it will discharge through the inductor. The capacitor doesn't discharge in a single blue flash, but discharges quite slowly because the inductor tends to oppose any change in current through it. As the capacitor starts to discharge, the current in the inductor slowly increases and a magnetic field builds up around the coil. When the capacitor is fully discharged, the magnetic field surrounding the inductor starts to collapse and as it collapses, it generates a current equal in magnitude to the original discharge current, but of opposite polarity (Fig. 1C); when the field around the coil is completely collapsed, the capacitor is recharged to the opposite polarity (Fig. 1D). However, as soon as the capacitor is recharged, it again seeks equilibrium and discharges through the inductor (Fig. 1E); the magnetic field builds up, and when the capacitor is completely discharged, the field collapses, recharging the capacitor to its original polarity (Fig. 1G).

This action happens over and over again, with the capacitor and inductor exchanging

electrical energy. If there were no losses, this circuit would continue to oscillate back and forth as long as the coil and capacitor were connected in parallel. However, in practical circuits, the coil exhibits a certain amount of resistance and the capacitor doesn't quite regain a complete recharge on each succeeding cycle. The result is that the oscil-

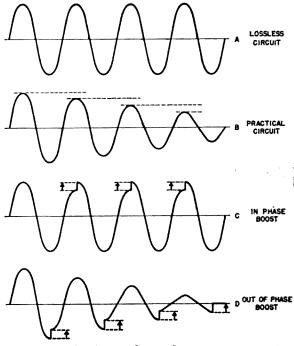
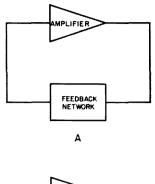


Fig. 2. Idealized waveforms for various operating conditions in harmonic oscillators.



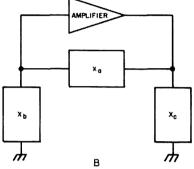


Fig. 3. All harmonic oscillators consist of an amplifier and a frequency-selective feedback network as shown in A. In the popular Colpitts and Hartley circuits, the feedback network consists of three reactances, X_a , X_b , and X_c as shown in B.

lations slowly decline in magnitude as illustrated in Fig. 2B. To maintain oscillations, a small amount of energy must be added to the circuit once each cycle as illustrated in Fig. 2C. It is here that the transistor or vacuum tube must be used, to provide the little kick of energy once each cycle.

This little kick of energy is a lot more complex than it would appear at first glance. First of all, it must be just large enough to overcome the inherent losses of the circuit; and second, it must occur at just the right time. If the boost does not occur at precisely the right time, it will either do nothing at all, or it will result in the rapid demise of oscillations as shown in Fig. 2D.

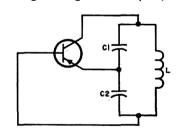
Actually, any oscillator may be represented by an amplifier and a frequency selective feedback path similar to that of Fig. 3A; by looking at this block diagram for a moment, we can see exactly what the requirements are for oscillation. First of all, we know that the amount of energy contributed by the amplifier to the tuned circuit must be exactly equal to the energy lost through circuit resistance. In other words, we want an output that is exactly equal to the input; the total gain through the amplifier and frequency selective feedback network must be equal to one or unity.

The other requirement for oscillation is that the kick must occur at just the right time. This is not really so difficult to do once we sit down and think about it—all we are saying is that the kick furnished by the amplifier must be in phase with the oscillator ouput. Since there is a 180° phase shift through the transistor from base to collector, the tuned feedback circuit must provide another 180° phase shift so that the output signal appears in phase with the input. In summary then, to function as an oscillator, the amplifier and frequency selective network must exhibit a total gain of unity and a phase shift of zero (or 360) degrees.

In the two most popular oscillator creuits, the Colpitts and Hartley, the frequency selective feedback path consists of three reactances denoted as Xa, Xb and Xc in Fig. 3B. In the Colpitts oscillator, Xa is an inductor and Xb and Xc are capacitors. In the Hartley circuit, Xa is a capacitor and Xb and Xc are inductors.

Colpitts oscillator

In the transistor version of the popular Colpitts oscillator in Fig. 4 and 5, capacitors C₁ and C₂ form a resonant tank circuit with the inductance L. A small fraction of the current flowing in the tank circuit is fed back to the base of the transistor through C₃. Although the oscillation frequency is determined primarily by the tank components C₁, C₂, and L, the transistor input impedance (h_{1b}) and output impedance (h_{ob}) affect it



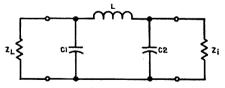


Fig. 4. The basic Colpitts oscillator. Bias resistors and power supplies have been left out for clarity. Since the input and output impedances of the transistor (Z_{i} and Z_{L} respectively) load the tuned circuit, the circuit may be further simplified by replacing the transistor with two resistors representing the loading.

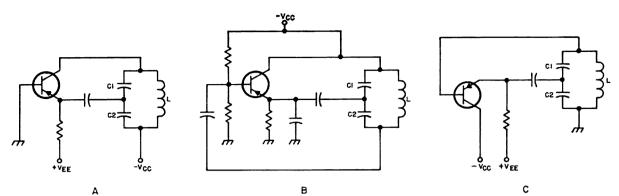


Fig. 5. Practical transistor Colpitts oscillators. The common-base connection is shown in A, the common-emitter in B and the common-collector in C. C3 is the unmarked capacitor connected to the junction of C1 and C2.

slightly. The frequency of oscillation is given by

$$f = \frac{1}{2\pi} \sqrt{\frac{1}{LC_T} + \frac{h_{ob}}{h_{1b}C_1C_2}}$$

where C_T is the equivalent capacitance of C_1 and C_2 in series:

$$C_{\text{\tiny T}} \; = \; \frac{C_{\text{\tiny 1}}C_{\text{\tiny 2}}}{C_{\text{\tiny 1}} \; + \; C_{\text{\tiny 2}}}$$

Fortunately, the term (h_{0b}/h_{1b}C₁C₂) is usually quite small, and the frequency of oscillation may be simplified to

$$f = \frac{1}{2\pi \sqrt{LC_r}} = \frac{0.157}{\sqrt{LC_r}}$$

This formula is not difficult to work if you're familiar with the slide rule, but its solution can be quite tedious if done by hand. The nomograph of Fig. 6 does all this work for you. In fact, Fig. 6 may be used in any case where the resonant frequency of a tuned LC circuit must be determined.

For more accurate results, the more complex equation including the term (hob/hibCiC2) must be used. In solving this formula, the nomograph will not work. However, usually a slug-tuned coil is used in a practical circuit, so the oscillator may be adjusted to the correct frequency after the oscillator is constructed.

Although predicting the frequency of oscillation is important, it has been previously noted that just any combination of inductance and capacitance that is resonant at the desired frequency will not necessarily cause the circuit to act like an oscillator. From the diagram of Fig. 4 it can be seen that the portion of energy circulating in the tank circuit which is fed back depends upon the size of C₁ and C₂. To ensure that the oscil-

lator will start and sustain oscillations when voltage is applied to the circuit, the common-emitter current gain (h_f₀) must be greater than the ratio of C₂ to C₁.

$$h_{f \bullet} > \frac{C_3}{C_1}$$

where he is the value of forward current gain at the frequency of interest.

Frequency stability

In addition to these two requirements, there is one other important consideration when designing an oscillator-that of frequency stability. Frequency stability is extremely complex because it varies with changes in temperature, power supplies, external circuit components and circuit Q. In addition, frequency drift is a function of amplification, and through amplification, of the collector voltage and emitter or base current. It is also a function of the effective impedance of the tuned circuit, and that impedance is a function of the coupled loads reflected from the input and output loads of the transistor-complex, to say the least. If frequency stability is of paramount importance, the first thing to do is to insure that only a small amount of power is taken from the tank circuit. In most cases a good buffer amplifier will effectively isolate the oscillator from loading and load variations and eliminate many problems with drift.

Theoretically, the frequency stability of an oscillator is independent of the configuration in which the transistor is used. However, degradation of circuit Q by transistor loading and amplification variations must be identical; in practice this is difficult to achieve. This being the case, the best stability can be expected for the circuit arrangement which provides the smallest load-

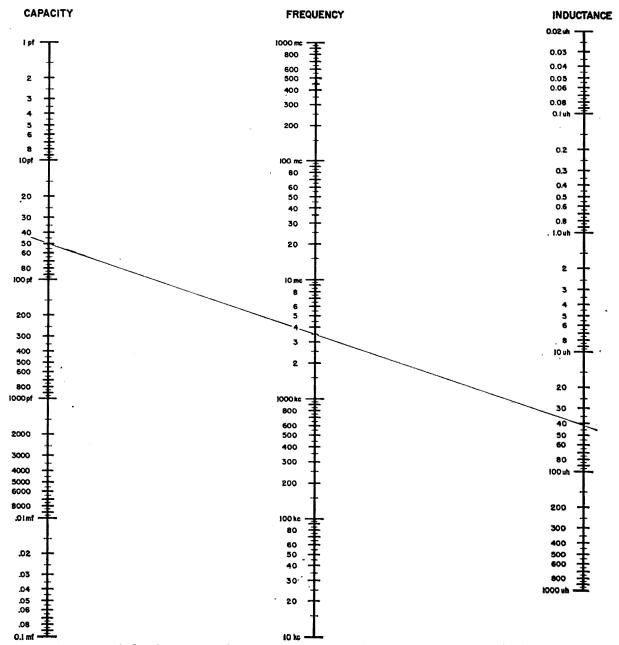


Fig. 6. Nomograph for determining the resonant frequency of tuned circuits. It may also be used to find the value of capacitance which will resonate at a given frequency with a given coil, or vise versa. A ruler is laid across the two known quantities and the third may be easily found. In the case illustrated, 42μ H resonates at 3.5 MHz with a 50 pF capacitor.

ing and the smallest variation in gain. The common-base circuit has reduced stability because of the large input signal power required by the emitter and because of the transistor's reduced power gain when conpared to the common-emitter configuration.

The selection of a configuration between the common-emitter (CE) form and the common-collector (CC) or emitter-follower configuration is much more difficult. The power gain of a CC amplifier is much smaller than the CE, but the uniformity of both in loading and gain are much better; consequently, selection between the two can be rather difficult. If the common-emitter circuit is properly designed, it can provide an excellent high stability oscillator; otherwise, the emitter-follower circuit often gives the most stable arrangement. This is borne out by the large number of Clapp and Q-multiplier type emitter-follower oscillators. The improved drift characteristics in both cases is a result of the reduced and uniform loading of the transistor on the tumed circuit and more uni-

form gain.

Temperature variations which result in frequency drift may be largely neutralized by proper biasing techniques or by using temperature sensitive capacitors in the tank circuit. Although the design of bias networks is beyond scope of this article, there have been several excellent articles and books written on the subject. Essentially, the bias resistors must be chosen so that the operating point remains relatively fixed with changes in the outside environment. This may often be done economically by using temperature-sensitive resistors; the temperature dependence necessary to stabilize the frequency may be determined quite easily.

A variable resistance is simply inserted into the circuit in place of the temperature-sensitive element. Then the circuit is exposed to the projected temperature range and this resistance is varied to keep the frequency constant. The temperature dependence of the temperature-sensitive resistor is then selected to match the measured temperature curve. This resistance may not necessarily keep the bias point constant, but it will change in such a way that it maintains a constant frequency of oscillation, compensating for more than one fluctuation in the circuit as a function of temperature.

A temperature sensitive capacitor in the tank circuit may be selected by the same technique—a variable capacitor is placed across the tank and adjusted for constant frequency output at the temperature extremes. The compensating capacitor should be chosen to follow the same curve.

Although temperature considerations and circuit loading are both very important to frequency stability, low drift is primarily dependent upon the Q of the tank circuit. All other things being equal, the higher Q circuit always results in lower drift. When the effects of temperature and circuit loading are neglected, the percent of drift is a direct function of Q as shown in Fig. 7. With proper temperature compensation and very light loading, the frequency stability obtained in a practical circuit will very closely approach this curve.

In addition, the tank L/C ratio should be low; this results in a larger value of capacitance in the tank circuit to filter out harmonics which tend toward frequency instability. Also, the self-resonant frequency of the inductors and capacitors in the tank circuit should be at least ten times the operat-

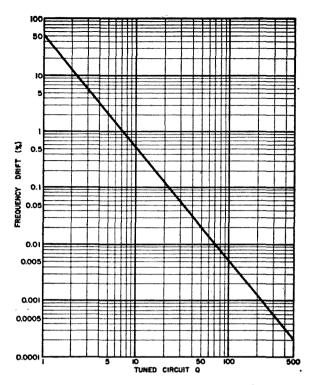


Fig. 7. The affect of tuned-circuit Q on frequency drift in an oscillator. For maximum frequency stability in a practical circuit, the Q should be as high as possible.

ing frequency of the oscillator, and where possible, even larger. Otherwise, the internal parasitic parameters of these tank components will seriously degrade oscillator performance to the point that stability will be unsatisfactory.

Colpitts oscillator design

Since frequency stability is usually the first consideration, circuit Q is a good place to start the design of a transistor oscillator. From the graph of Fig. 7, you can choose a value of Q that is compatible with practical components and will provide the frequency stability required. With this value of Q in mind, the frequency of operation and the desired impedance of the tuned circuit at resonance, the correct value of tank capacitance may be found from

$$C = \frac{Q}{2\pi fZ}$$

Again, the math in this formula, although not completely formidable, is inconvenient, so the nomograph of Fig. 8 was prepared to give you an almost instant answer; the nomograph has the added advantage that you can quickly check the effect of various values

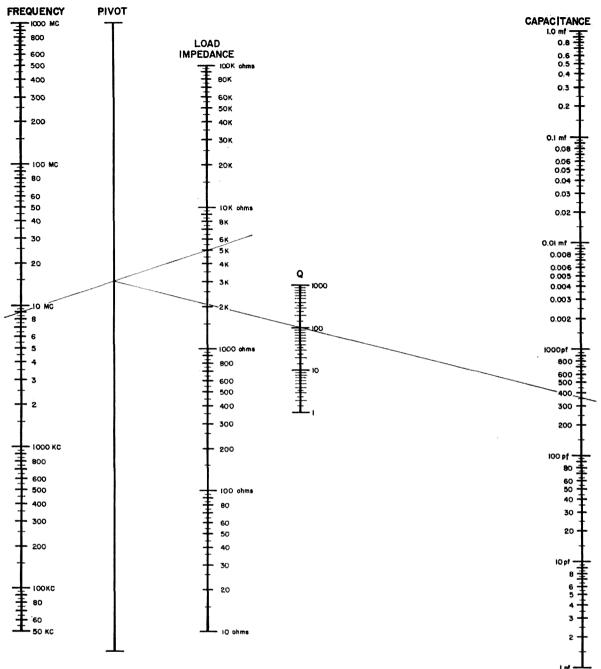


Fig. 8. Nomograph to determine the required tuned-circuit capacitance when frequency, circuit $\overset{\frown}{Q}$ and load impedance are known. First the frequency of operation and load impedance are plotted. A straight line is then drawn from the cross-over point on the pivot line through the required value of circuit $\overset{\frown}{Q}$ to find the necessary tuned-circuit capacitance. In the example illustrated, a 9 MHz oscillator with a 5000-ohm load impedance and circuit $\overset{\frown}{Q}$ of 100 requires a 355 pF capacitor. In addition to its use in oscillator design, this nomograph may also be used when designing rf and if amplifiers, transistor or vacuum tube.

of tank capacitance.

For example, let's assume that you want to build an oscillator at 9 MHz with a circuit Q of 100; the load impedance is chosen to be 5000 ohms. From the nomograph, plot a straight line between 9 MHz on the frequency scale and 5k on the load impedance scale; note where this plot crosses the pivot

line. Now plot a line between the cross-over point on the pivot line and 100 on the Q scale to find the required value of capacitance; in this case about 355 pF. To find the value of inductance that resonates with 355 pF at 9 MHz, use the nomograph of Fig. 6.

Before we can go any further, we must

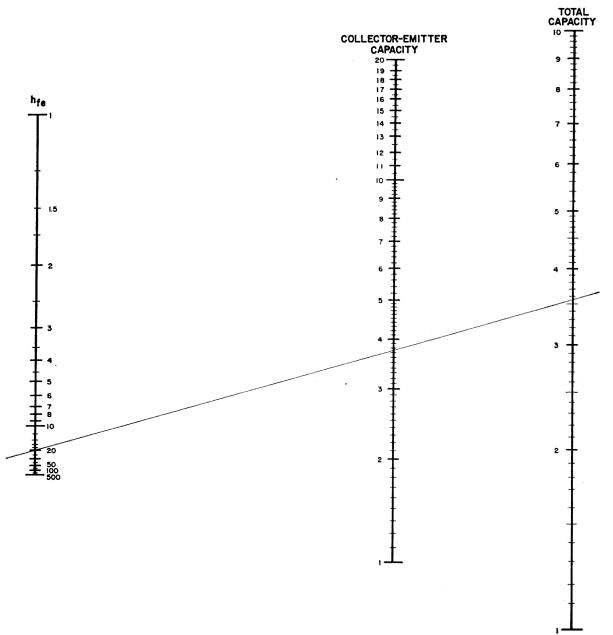


Fig. 9. Nomograph to find the required collector-emitter capacitor in a transistor Colpitts oscillator when the forward current gain (h_{fo}) and total tuned-circuit capacitance (C_T) is known. In this case, forward current gain of 20 and total tuned-circuit capacitance of 355 pF requires a collector-emitter capacitor of 375 pF.

determine the impedance of the tuned circuit at resonance. For maximum power again, the tank impedance should be equal to the transistor output impedance; this may be found from

$$Z \ = \frac{V_{\text{ce}^2}}{2P_{\text{o}}} \ \text{or} \ \frac{V_{\text{ce}^2}}{I_{\text{c}}}$$

where P_{\circ} is the output power, V_{CE} is the voltage between collector and emitter, and I_{C} is the collector current. In practice a value in the range from 1500 to 5000 ohms is

usually used.

The only other consideration is what transistor to use. Theoretically, the oscillator transistor only requires a gain of one or unity, but in practical circuits the gain must be greater than unity because if it were not, aging of the components would eventually result in discontinuance of the desired waveform because of gain reduction. The minimum excess gain that will assure starting is usually about 50 to 100 percent for ordinary circuits. When the gain is greater than one,

more signal is fed back than was originally present, and a buildup in signal level results; however, this increased signal will always be limited by the inherent nonlinearities in the transistor. These nonlinearities will result in some distortion of the output waveform, but in good oscillator design the distortion should be very slight.

Now that we have all the information we need, we can design a Colpitts oscillator for any frequency we desire. Perhaps the best approach at this point is to lay out a "recipe" that will provide us with the desired results:

1. Choose a transistor that has an fr several times greater than the frequency of operation; it should have a value of forward current gain (h...) of at least 5 at the frequency of oscillation.

2. Design a bias network which will result in the desired operating conditions. Use the manufacturers recommended operating

point.

3. With the operating frequency, desired load impedance and required circuit Q in mind, find the proper value of tank capacitance from the nomograph in Fig. 8.

4. The total tank capacitance (C_T) found in step 3 is equal to the equivalent capacitance of C_1 and C_2 in series. These capacitors must have a ratio that satisfies the equation $h_{t \bullet} > C_2/C_1$. Since the forward current gain of the transistor should be about five times greater than that required for oscillation, this condition is satisfied if we use a starting value of $h_{t \bullet}$ in choosing C_1 and C_2 . The starting value of $h_{t \bullet}$ is simply found by using % of the actual transistor $h_{t \bullet}$ in our calculations. This will ensure an adequate margin of safety in our design.

When the total capacitance (C_T) and starting h₁₀ are known, the value of the collector-emitter capacitor (C₁) may be found from the nomograph of Fig. 9. Then the required value of emitter-base capacitance (C₂) may be calculated by multiplying C₁ by the starting h₁₀.

5. From the nomograph of Fig. 6 choose a value of inductance that will resonate with the total capacitance at the desired

operating frequency.

This recipe may seem to be a little complex at first, but as soon as you use it, you will find that it is really pretty simple; all the drudgery is removed by the three nomographs.

To illustrate the use of the Colpitts' recipe, let's design an oscillator for 9 MHz with a 2N918 transistor. At 10 MHz the 2N918 has a gain of about 20, so we can use this value at 9 MHz. A check with the manufacturer's spec sheet shows that 1.5 mA collector current (I_c) and 7.5 volts collector-emitter voltage (V_{CE}) is a good operating point. A ninevolt power supply, a 1000-ohm emitter resistor, a 2200-ohm stabilization resistor and a 6800-ohm base-bias resistor will satisfy the biasing requirements (Fig. 10). The required load impedance can be found from Z = V_{CE}/I_c; in this case 7.5 volts/1.5 mA = 5000 ohms.

Choosing the value of circuit Q to be 100, a load impedance of 5000 ohms and operating frequency of 9 MHz, the total tank circuit capacitance from the nomograph of Fig. 8 is 355 pF. To insure starting, use % the value of h₁₀ in finding the values of the feedback capacitors; since the value of h₁₀ in this case is 20, use a value of 4. From the nomograph of Fig. 9 the collector-emitter capacitor (C₁) is found to be 444 pF; use the next largest standard value, 470 pF.

The emitter-base capacitor is found by multiplying 444 pf by the starting he, 4:

$$C_2 = h_{10}C_1 = 4 \times 444 = 1756 \text{ pF}$$

Here again use the next largest standard value, 1800 pF.

Now that the feedback capacitors have been chosen, all that is left is the inductor. From the nomograph of Fig. 6, the value of inductance that will resonate with 355 pF at 9 MHz is 0.84 μ H. This will be a little bit off because we used standard values of capacitance, but if a slug-tuned coil is used, it will compensate for these larger values as well as the output capacitance of the transistor and any stray capacitance introduced

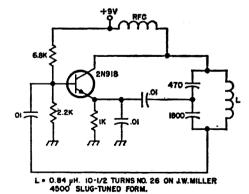


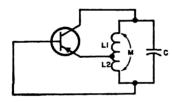
Fig. 10. Precticel 9 MHz Colpitts oscillator designed with the procedure outlined in the text.

by wiring.

The completed circuit is shown in Fig. 10. When this circuit was constructed on the bench, it started oscillating as soon as power was applied. The collector current was 2 mA and the collector to emitter voltage was 7 volts—very close to the desired operating condition. The frequency could be tuned from 8.7 to 11.6 MHz by tuning the slug-tuned coil. The output voltage, measured at the collector with a VTVM and rf probe, was 4.4 volts peak to peak.

Hartley oscillator

The Hartley oscillator in Fig. 11 and 12 differs from the Colpitts in that the capacitors in the Colpitts circuit are replaced by two magnetic-coupled inductors in the Hartley configuration, and the inductor is replaced by a capacitor. The behavior of the Hartley circuit differs in one significant way from that of the Colpitts; if the magnetic coupling between the two sections of the inductor is relatively high (it usually is),



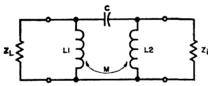


Fig. 11. The basic Hartley oscillator without bias resistors and power supplies. The circuit may be further simplified as shown by substituting resistors Z_{ε} and Z_{z} for circuit loading by the transistor.

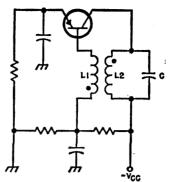


Fig. 13. The two-winding version of the Hartley oscillator. In this circuit the necessary phase reversal is obtained by connecting the transformer as shown by the dots.

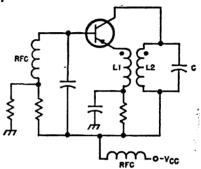


Fig. 14. Another version of the two-winding Hartley oscillator. In this case, since the drive is applied to the emitter, no phase reversal is required and the transformer is connected as shown.

then transformer action can be utilized to obtain the required current gain to the output of the circuit. Consequently, smaller values of Q-factor can be used for the tuned circuit without loss in circuit efficiency.

In most cases the loading of the Hartley circuit is relatively unimportant as long as the coupling coefficient between the two windings on the inductor is high. If the coupling coefficient is small, then the circulating current in the tank must be large compared to the load current (implying light loading) as is the case with the Colpitts

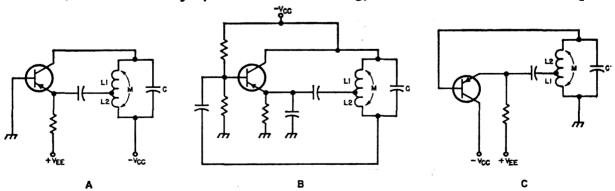


Fig. 12. Practical transistor Hartley oscillators. The common-base configuration is shown in A, the common-emitter in B and the common-collector in C.

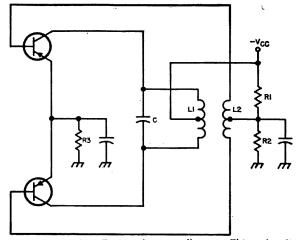


Fig. 15. Push-pull Hartley oscillator. This circuit may be designed for greater power and less harmonic output than single transistor circuits.

oscillator.

Although the inductance in the Hartley circuit is usually a tapped coil, a transformer with separate primary and feedback windings may be used. This particular arrangement allows an additional degree of flexibility in that it is possible to obtain the dc bias from the collector supply or from a separate dc source. For higher power

output and greater efficiency, the Hartley circuit may be readily modified for push-pull operation by providing center-tapped primary and feedback windings on the transformer. In Fig. 15 oscillating currents flow in the tank circuit formed by the winding L₁ and the capacitor C₁. Winding L₂ feeds back sufficient energy to the bases of the transistors to maintain oscillation. If the transistors are operated in class B or C, substantially greater efficiency and output power may be obtained than from the single transistor version.

In some respects the design of a Hartley oscillator closely follows that of the Colpitts, but as you might expect, the tap point on the inductor is found in a somewhat different manner. To insure that the Hartley oscillator will start, the value of hre must be

$$h_{f \bullet} > \frac{L_1 + M}{L_2 + M}$$

In this case, like the Colpitts, the value of hre used will be about % the actual hre of the transistor at the operating frequency.

Unfortunately, this formula contains the mutual inductance factor (M) which is dependent upon the coupling coefficient. And

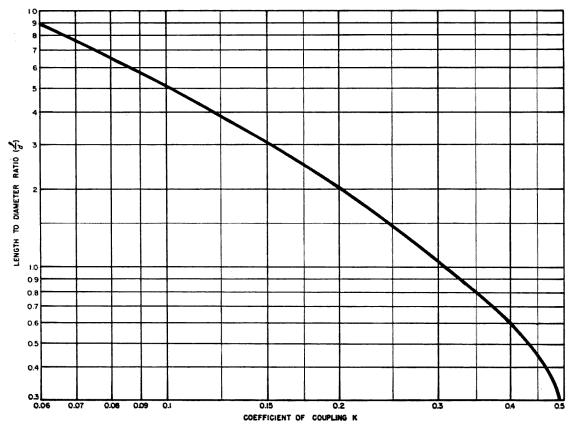


Fig. 16. The approximate coupling coefficient (k) of a single wound tapped coil as a function of the coil size.

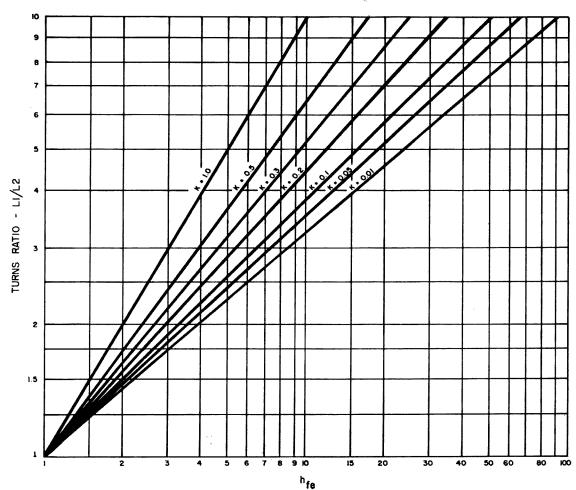


Fig. 17. Graph for determining the tap point on the tuned-circuit inductor in a transistor Hartley oscillator when the forward current gain (h_{fe}) and coupling coefficient (k) of the coil are known.

-the coupling coefficient is dependent upon the size of the coil and the tap point. Because of all the inter-related dependencies, it's a little tough to come up with the proper tap point on the first try, but by approaching the middle from both ends, the graphs of Fig. 16 and 17 will simplify things.

Once the total inductance is decided upon, the coil can be designed using conventional techniques. When the length and diameter of the coil are determined, the coefficient of coupling can be approximated from Fig. 16. With this value of coupling coefficient (k) and the starting value of hre, the necessary turns ratio can be found from Fig. 17. Although both of these curves are approximations, they will get you into the ball park with an operating unit; the oscillator can then be optimized for maximum efficiency and power output.

With these points in mind, we can come up with recipe for the transistorized Hartley oscillator:

1. Choose a transistor that has an fr sev-

eral times greater than the frequency of operation; it should have a value of forward current gain (hre) of at least 5 at the frequency of oscillation.

2. Design a bias network which will result in the desired operating conditions. Use the manufacturers recommended operat-

ing point.

3. With the operating frequency, desired load impedance and required circuit Q in mind, find the proper value of tank capacitance from the nomograph in Fig. 8.

4. From the nomograph of Fig. 6 choose a value of inductance that will resonate with the tank capacitance found in step 3 at the desired operating frequency.

5. Design an inductor that will fit the requirements of step 4; the inductance curves in the ARRL Handbook and the inductance nomograph in the Radio Handbook³ will eliminate some tedium here.

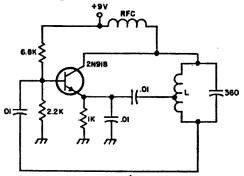
6. When the length and diameter of the inductor are known, the length to diameter ratio may be calculated and the coupling coefficient found from Fig. 16.

7. The required turns ratio between L₁ and L₂ may be found from Fig. 17 by using the coefficient of coupling from step 6 and the *starting* h₁.

As with the Colpitts design, the best way to illustrate the Hartley recipe is to go through a practical example for a Hartley oscillator with a 2N918 transistor at 9 MHz. Since the same transistor is being used, the bias network and total tank capacitance and inductance will be identical to the Colpitts oscillator we previously designed. In this case, however, we have to design the inductor before we can proceed. By scanning the data sheet, we find that 10½ turns of number 26 enameled wire on a J. W. Miller 4500 form will pretty closely put the target value of 0.84 µH midway in its range. Since the total length of the coil may be found by multiplying the wire diameter times the number of turns, and number 26 enameled wire is 0.017 inches in diameter (from the wire table in the ARRL Handbook), the length of the completed coil will be 10.5 x 0.017 = 0.170 inches.

The diameter of the Miller 4500 coil form is 0.260 inches, so the length to diameter ratio is 0.179/0.260 or 0.69. From the graph of Fig. 16 a 1/d ratio of 0.69 provides a coefficient of coupling of approximately 0.35. From Fig. 17 a 0.35 coefficient of coupling and starting hr. of 4 indicate a turns ratio between L₁ and L₂ of 2.6.

This turns ratio and the total number of turns may be used to find the tap point on the inductor. To find the number of turns in La, simply add one to the turns ratio (which gives 3.6 in this case) and divide this factor into the total number of turns. In this example $L_a = 10.5/3.6 = 2\%$ turns.



L=10-1/2 TURNS NO. 26 ON LWMILLER 4500 SLUG-TUNED FORM. TAP 2-3/4 TURNS.
FROM BOTTOM:
Fig. 18. Practical 9 MHz transistor Hartley oscillator designed with the procedure described in the

Inductor L₁ is the rest of the coil-7% turns.

The completed circuit is shown in Fig. 18. Like the Colpitts circuit, this oscillator took off as soon as the nine-volt supply was connected. The desired operating condition was very close to that required—Vox of 7.2 volts and Io equaled 1.8 mA. The output voltage, at the collector, was 3.8 volts peak to peak and the tuning range was almost identical to the Colpitts circuit previously constructed—8.6 to 11.5 MHz.

Clapp oscillator

Another popular oscillator circuit is the series-tuned Colpitts or Clapp circuit shown in Fig. 19. This circuit is especially useful to the amateur because in practice it is susceptible to less drift. This is because the tuned-circuit capacitors C₁ and C₂ may be made so large that they swamp out the effects of element capacitance in the transistor. The large values of capacitance also tend to minimize harmonics, further increasing frequency stability.

No recipe for Clapp oscillator design will be given, because in practice the design very closely follows that of its parent, the Colpitts. Usually the values of C₁ and C₂ are so large that the resonant frequency of the circuit is determined primarily by the value of C₃. Since the capacitors C₁ and C₂ govern the amount of feedback, their ratio may be found by using the procedure outlined in step 4 of the Colpitts recipe. The value of C₃ may be found from the nomograph in Fig. 8, and the inductance, from Fig. 6.

Since the Clapp oscillator is usually used in a VFO, capacitor C₀ is a variable. This is the tough part—to choose a combination of inductance and capacitance (C₀) that will cover the desired range. Although this can

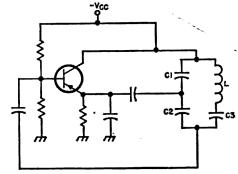


Fig. 19. The transistor Clapp oscillator. Excellent frequency stability can be obtained with this circuit because the capacitors C_z and C_a may be made large enough to swamp out any capacitive effects of the transistor.

text.

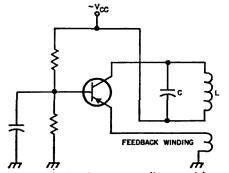


Fig. 20. A tuned-collector oscillator with a feed-back winding to the emitter.

be given mathematically, the resulting formula is long and drawn out.⁴ The best approach is to design for the center of the required frequency range, and then juggle the values of L and C₃ to exactly what you want. If you use a value of C₄ which is slightly smaller than what your calculations call for, a padding capacitor can be placed in parallel with it to provide the necessary capacitance adjustments.

Other oscillator circuits

In addition to the Hartley and Colpitts circuits, there are obviously many different ways to satisfy the condition for oscillation. In the tuned-base tuned-collector oscillator

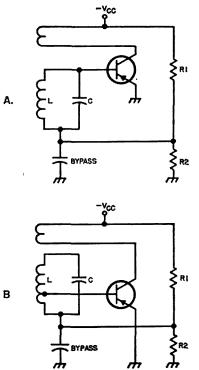


Fig. 21. A tuned-base oscillator with feedback from the collector winding. A better impedance match to the base of the transistor may be obtained by using the tapped inductor as shown in B.

for example, a series LC combination is inserted in both the base and collector leads, which together form the necessary resonant circuit. Fig. 20 shows an oscillator with the tank circuit connected between the collector and base with feedback taken off the tank circuit by the in-phase feedback winding and applied to the emitter.

In the circuit in Fig. 21, the tuned tank circuit is placed between the base and emitter (through ac ground) and out of phase feedback picked up from the collector winding. In Fig. 21B a better impedance match to the base of the transistor is obtained by tapping down on the tuned-circuit inductance

Most of these simple circuits have one very serious disadvantage—the frequency of oscillation is very dependent upon the collector resistance of the transistor. There is some dependence on the transistor characteristics in all oscillator circuits, but in the circuits of Fig. 20 and 21, the influence of the transistor predominates.

Colpitts or Hartley?

One of the big questions that invariably arises is what circuit to use in a specific application. In many cases the Clapp oscillator is chosen, particularly for VFO's, because in practice stability is somewhat easier to obtain. For other applications though, both the Hartley and Colpitts find favor. Between these two the choice is more difficult. However, as a rule of thumb, the Hartley is more satisfactory at the lower frequencies, while the Colpitts works best in the high-frequency and VHF range. The reasons for this are quite complex, but they can be explained fairly simply with a couple of block diagrams.

In all transistor oscillators where the tuned circuit is connected between the collector and emitter, the feedback network may be represented by X₁, X₅ and X₆ as shown in Fig. 22. Neglecting circuit losses, the only way that the voltage across Zi (the base input impedance) can be precisely 180° out of phase with Z_L (collector impedance) is for the reactance X₄ to be opposite from the reactances X_b and X_c and for X_c to be equal to the sum of X_b and X_c. In the Colpitts oscillator X_b and X_c are inductors and X_b is a capacitor. When the circuit losses are neglected, at resonance the input impedance of the feedback network in Fig. 22A appears as an infinitely large resistance.

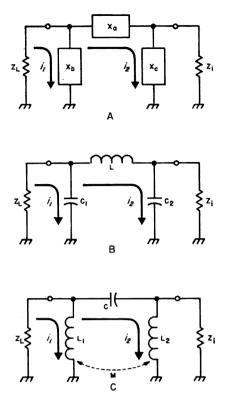


Fig. 22. The current flow in the feedback paths of the Colpitts and Hartley oscillators is shown in B and C. The general case is illustrated in A.

However, in a practical circuit there is base loading, series resistance in the tank coil, loading due to power being coupled from the circuit and the impedance is not purely resistive. In a practical Colpitts oscillator for example, the feedback circuit would be represented as shown in Fig. 22B; Z_L is the output impedance of the transistor, while Z₁ is the input impedance. In this circuit currents is and is are not exactly the same magnitude or of opposite phase as in the ideal lossless circuit. The loading of the base circuit (Z₁) causes the current i₂ to lag the collector driving voltage across Z_L by less than 90°; hence the base driving voltage lags the collector driving voltage by something less than 180°.

On the other hand, in the Hartley circuit represented in Fig. 22C, the base loading causes the current iz to lead the base driving current by less than 90° and therefore the base driving voltage leads the collector voltage by less than 180°.

In the Hartley oscillator the effect of circuit losses and transit times are accumulative, but in the Colpitts circuit these effects tend to offset one another. The fact that the base driving voltage through the Colpitts feedback circuit lags the collector voltage par-

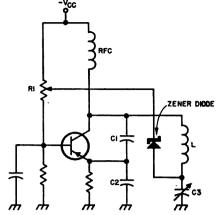


Fig. 23. Connecting a zener diode across the tank circuit of a Clapp oscillator to obtain output stability.

tially compensates for the effects of transit time. For this reason the Colpitts oscillator is somewhat superior to the Hartley circuit at the high and very high frequencies.

Oscillator requirements

The requirements on any oscillator circuit are varied, but in addition to frequency stability, there are several important characteristics which serve to specify the performance of any particular circuit. Perhaps most important of these are amplitude stability, harmonic content, output power level, efficiency and noise output.

Amplitude stability

It is usually desirable for the output signal to remain constant within certain limits as the transistor and other components age during operation. This is particularly a problem with variable frequency oscillators, but fortunately the output may be stabilized in most cases by one of the techniques described below. Theoretically, the amplitude of the voltages and currents in an oscillator will become infinite unless some limiting action occurs somewhere in the circuit. The nonlinearities which will limit the amplitude of the output in a practical circuit are:

- 1. Limitation of the available dc voltage or current by the capability of the supply.
- 2. Nonlinearities in the transistor.
- 3. Nonlinearities in external loads. This is true because the external loads are often a function of voltage and current; above a certain amplitude their values change so that the condition for oscillation is no longer satisfied.

In any case, the amplitude of oscillation will build up until it is limited by one of these three basic limiting mechanisms.

When the oscillator is designed for high efficiency and the output voltage nearly equals the supply voltage, variations in the supply will cause fluctuations in output power. These fluctuations may be eliminated by stabilizing the supply voltage with a zener diode.

Another technique which is slightly more sophisticated has been successfully applied to variable frequency oscillators (Fig. 23). Here the output is compared to a reference diode and the difference fed back to the transistor. Whenever the ac voltage across the capacitor in this Clapp oscillator exceeds a value determined by the variable resistor R3, the diode conducts a compensating base current and reduces the output amplitude.

Harmonic content

In many applications it is desirable to restrict the output power of the oscillator to one single frequency. In other cases harmonics are desirable for frequency multiplying. There are always certain nonlinearities in an oscillator circuit which give rise to signals as multiples of the fundamental. The harmonic content depends on many factors and is as difficult to control as is stability, but primarily it is dependent upon the nonlinearities in the circuit and the filtering action of the tank capacitance. If very low distortion is desired, push-pull operation in a two-transistor oscillator may be advised. On the other hand, nonlinearities may be deliberately used to produce frequency multiplication. This is done by incorporating another tank circuit into the oscillator which is tuned to the desired harmonic.

Output power level

The maximum power output from an oscillator is important in many cases, as well as the maximum voltages and currents available within the limitations of stability and harmonic content. The requirements for frequency stability and harmonic content are closely connected with the power, voltage and current-handling characteristics of the transistor used in the circuit.

The conversion efficiency of the transistor oscillator depends primarily on the class of operation and increases as you go from class A to B to C. However, the circuit must be initially biased somewhere in the active re-

gion to insure that the oscillator will be self-starting. With most transistors, efficiencies of about 50% in class A, 78% in class B and 80-90% in class C may be expected.

A bypassed emitter resistor permits class C operation in a manner somewhat similar to the grid-leak method used with vacuum-tube oscillators. An average voltage builds up across the emitter RC combination that provides reverse bias for the emitter diode. With an initial operating point near cutoff, rising oscillations will first result in clipping at the low-current end of the load line, and eventually the buildup will be limited by the nonlinearities at the high current end; the operating point will eventually lie in the cutoff region.

The efficiency of an oscillator is reduced by the dc losses in the resistors of the bias circuit and is tied in very closely with the required operating point stability and ease in getting the oscillator started. AC losses in the resonant tank also reduce efficiency, and a high unloaded Q in the tank circuit is desirable. To obtain high efficiency it is necessary in all classes of operation to utilize as much of the available dc supply voltage as possible, with the peak ac collector voltage being equal to approximately 90% of the supply voltage.

In addition, the output power delivered by the transistor to the tank and load must be high. This means that the load impedance seen by the transistor must be designed to be as close as possible to the matching impedance for the transistor. If the output power from the oscillator is specified, then the supply voltage should be only a few percent higher than the ac voltage swing necessary to deliver the required power into this approximately matched load impedance.

Unfortunately, the requirement for high efficiency will lead to low Q of the *loaded* tank circuit. This may cause poor frequency stability and a compromise must be found.

Noise output

In many applications it is very important to keep the noise power from the oscillator at a minimum. This is particularly true in VHF converters where a minimum of noise should be injected into the mixer.

Noise in the transistor also effects frequency stability—the initiation of oscillation is a result of thermal and other forms of noise shock-exciting the oscillator circuit,

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changing the over-all amplification and affecting the phase stability at the same time. Consequently, in oscillators that must meet extreme frequency stability requirements, the transistor must be very quiet at the operating frequency. In addition, the operating conditions should be selected to introduce a minimum amount of noise.

The design of transistor oscillators is not particularly amenable to a paperwork design, followed by building an optimum circuit on the very first try; in all cases the design must be accompanied by some experimental cut and try. The frequency of oscillation, the desired power output, and other requirements, such as frequency and amplitude stability are required with fluctuations in supply voltage and transistor perameters over certain temperature ranges. However, experience has shown that the following general procedure provides best results:

- Select a transistor capable of the desired power output and exhibiting sufficient gain at the frequency of oscillation.
 Select the type of oscillator circuit to
- 3. Establish the bias point and design a bias network with the necessary degree of stability. The bias point may be subject to change later to improve efficiency by shifting operation into class B or C.
- 4. Design the tank circuit using the given formula and design nomographs.
- 5. Try varying amounts of feedback to optimize efficiency; vary the operating point to achieve class B or even class C operation without sacrificing ease in getting the oscillator started (the emitter junction must not lock in the reverse-biased condition).
- 6. Use a slug-tuned coil or trimming capacitor to make final adjustment, if necessary, of the frequency of oscillation.

... W1DTY

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Gus: Part 26

Tristan de Cunha

When last month's episode ended, I was on board the South African ice breaker, departing Capetown for the first scheduled stop at Tristan da Cunha. Jack (ZSIOU) and I had gone aboard the ship a few days earlier. We had installed the gear in my little stateroom and it was ready to go. I watched the city of Capetown slipping away in the distance as we headed in a general Northwesterly direction.

After about an hour or so, the Captain said it was OK to use the radio gear, so I headed back to my little room, turned on the rig, re-calibrated the receiver and transmitter at 14100 kHz, then checked the SWR. It read almost 1:1 so I was all set. Out went the first CQ signing W4BPD/MM and I was back in business again. The boys were all there, no East Coast fellows to be sure, because the band wasn't open to them, but a goodly number of W6's and some W7's called. They all wanted to know when I expected to arrive at the island. I could only make an educated guess at this time, so I told them the approximate time. Then the Europeans began calling and all the info had to be given out again. This kept up for a few hours and since I was in no hurry, I

they requested. When the little pile-up died down somewhat, I decided to take a walk around the ship and meet all the crew again. I wanted to get to know them better and to see what kind of work each fellow was doing. The last one was the wireless operator. He was all shut off by himself in his little poopdeck. We had a long eye-ball QSO and I had a good chance to look over his Japanese built radio gear. It was beautifully built and seemed to work very FB. The nicest part was that I had no interference from him on the ham bands, and I didn't cause him any QRM either. This meant we could both operate at any time without bothering each

took it easy and gave them all the answers

other. Later I found that this is not usually the case when you set up a ham rig on a ship.

The ship had been built in Japan about five years before, so as far as ships go, it was practically a new one. The old diesels ran as smooth as a new Swiss watch. While on board the ship, I used to hang around the engine room looking at those two big diesels. Each one was about the size of an automobile and they purred like kittens. As near as I can remember, their cruising speed was about 300 RPM and I was told they usually last a lifetime.

It was always interesting for me to sit and look at the Radar on board the ship. It would even spot whales and waves in the distance if the gain were turned up. Then the depth finder was another item I found interesting. It would show every hill and vale down below the ship and it would even spot a school of fish now and then. Large fish could be easily seen and I believe if one were to study it for a while, he could tell the size of some of the larger fish.

Listening to the sounds from that depth finder made my flesh crawl. They were some of the wierdest sounds I've ever heard. You could hear the reflected echo from each of the objects shown on the CRT screen. This was something I had never observed before in my life and it always attracted me when I had nothing to do, especially late at night after the last cup of coffee. I had brought about five cases of Cokes along with me and I always kept a few of them in the ship's "Fridge", as they called it. Some nights i was coffee, other nights Coke—sort of depended on the mood I was in.

I spent many hours of the night sitting up on the top deck looking at the stranger arrangement of stars overhead in the Southern Hemisphere, with the Southern Cross about 45 degrees above the horizon. During the early morning hours quite a few whales

were spotted and each of them took a nose dive, straight down, as the ship approached. They were really some "whoppers" too.

Listening across the bands, when there was nothing else to do, was always interesting, especially if someone was talking about me. It did sort of shake them when I would break in and say, "Hey, Ole Buddy, you had better be careful, I am a lissenin' to what you say".

I had plenty of time to just sit and reflect and ask myself why I was down here, away from all the comforts of home and my nice family . . . especially sweet Peggy. The more a DXpeditioner thinks about it, the more he is convinced that the fellows back home in the air conditioned houses or apartments are actually getting more enjoyment out of the DXpedition than he is. It's like I have always said, the fun is in the chase, getting in the pile-ups, working that elusive and rare DX, then going in and telling the XYL about it . . . and she sometimes saying, "So what?". I am sure the only one who can appreciate the thrill of working a new one is a real DXer. The 75 meter rag chewers cannot understand all this, and you are wasting your time trying to explain to one of them how it is with you. But, you know, if every ham was a real DXer, the bands would be absolutely unusable. Can you picture the mess if the pile-ups were about 10-15 times as high as they are? The poor DXpeditioner would go stone crazy and would not make as many QSOs as he does at each stop.

Every chance I got, I would go on the air and sort of keep a running account of how we were approaching our goal—Tristan da Cunha. The South Atlantic seemed, on the entire trip, to be in a mean mood. There were never any of those near calms you sometimes see around the Seychelles in the Indian Ocean. Mind you, this was Summertime, so I can just picture what it must be like during the winter season down there. They tell me it gets pretty rough during those months.

One nice thing about being at sea is the superb conditions and the late hours the bands stay open. I had observed how early he bands closed when I was operating from LSIRM. They closed just about the way hey do in the USA, but it was a completely different story at sea. I hoped the bands would be like this when I finally got ashore at the places I was heading for.

I noticed that when the wind blew from

the Southwest at night it got downright chilly. Even during the daytime, it was too cool and too windy to enjoy yourself on the deck chairs. I suppose that cold air over Antartica must have had it's effect even at this distance from it.

Big schools of fish could be seen at all times, and I was amazed at the number of birds which could be seen from the ship all day long. Many of them seemed to be following the ship. Maybe they were lost and figured we would sooner or later bring them to land.

Food was no problem on the boat. There was plenty of good eating at every meal. Occasionally the crew had some beer. The Captain and First Mate treated me royally and I got almost everything I asked for. I was their guest and they really knew how to treat a guest. Maybe one of these days I will get a chance to go with them again. I would take them up on it tomorrow . . . maybe I should get a letter off to them one of these days, eh?

I have found that if you are friendly when you are away from the USA, everyone is then your friend. If you act "snooty" (like some people still do) then they know how to treat you. You can get "red taped" to death when you are at their mercy overseas, you know. So, Ole Buddy, take it easy over there. Be friendly to everyone and everyone will be friendly to you. Things will go much more smoothly for you. I think most people in the world want to be friendly and if you act right and say the right things, they will go all out for you when you need them.

This really pays off aboard a ship. If you like to eat, always make it a point to be on friendly terms with the head cook. Then you can always visit the galley at any old hour and get a real good handout, or a fresh cup of coffee, and you can get him to cook little things especially for you.

I got to know the three men who were going to Tristan da Cunha. They were part of the island's population which was forced to leave when the volcano exploded a year or two before. They spoke a very odd type of English, but were very friendly. They told me about someone else who had operated a ham station from the island some years earlier. The trip to the island took about 4 or 5 days. The days seemed short to me, since something was going on every day. It seems like yesterday to me, sitting here writing all this some years after it hap-

pened. Right now, I can almost hear those wierd sounds of the depth sounder going on all day and all night. I wonder how many of the old crew are still with the ship...or even if they are still using the same ship.

One morning the birds became more numerous than usual, and the ship's intercom announced that Tristan was being approached. In another hour, what appeared as a few mountains sticking up out of the water was seen on the horizon. There was a little smoke coming from one of them. The men from Tristan da Cunha became nervous and big smiles came over their faces. They began shaking hands with everyone. They were coming home after being away for a long time. As we came nearer, I could not understand how anyone would be anxious to get back to such a dismal looking spot. But it was home to them, I suppose, since each of them had been born there and had lived most of his life on those rocks. As for me, I sure would hate to know I had to spend the rest of my life on such a miserable island as this.

The ship anchored about half a mile off shore and a few small boats were placed in the water for some of the crew to go fishing for rock lobsters. Rock lobsters are very numerous in that part of the South Atlantic. The large landing boat was lowered and the three islanders, the first mate, three of the ship's crew, and I boarded the craft. We were lowered to the water and then headed for the island.

As we approached, I could see that it was even more desolate than it looked from the ship in the harbor. The color of the soil was almost black as coal and the spots where the lava had streamed from the volcano looked like frozen liquid coal. There were three or four streams of this lava which had flowed down to the sea from the volcano. I'll bet this was a sight to behold when it was actually taking place.

When we landed, the three men headed for their homes which were still standing. They went all over the place looking into the other houses. While this was going on, I was trying to figure out the best spot to put my antenna and which house to use as my ham shack. I discussed this with the First Mate, and that's when he told me they were planning to leave there the next morning, at the latest! The Tristaners decided they would stay, so when we got back to the ship, all their posessions, even a few goats

and sheep, were loaded into the landing craft and they went back to the island after shaking hands with everybody. I stayed on board the ship and went on the air to tell the fellows where I was and what we were going to do.

The fellows who had been fishing came back with a few rock lobsters and some nice looking fish. In the distance, we saw a ship approaching us. The fellows with the signal light got busy and had a QSO with them as they neared our boat. They pulled up alongside us and their Captain and First Mate, along with a few members of their crew, came over to our ship. We all went into the dining salon for a few cups of tea. They were in need of a few items in the food line, and a few drums of some kind of oil. In exchange for this, they gave us between 500 and 1000 pounds of rock lobster.

Their ship was one of two which stay in the waters around Tristan da Cunha many months of the year to fish for rock lobster. They had had a good catch, they said. They were practically a floating refrigerator and, when they were fully loaded, could carry many tons of lobsters. They take their boats back to Capetown when full, and most of these lobsters are then shipped by air to the USA. Their crew was a very rough looking bunch and hard as nails. These fellows had been following this business a long time, I was told.

We departed for Gough Island at about sundown. Everyone had a big plateful of rock lobster for dinner that night. Needless to say, they were delicious.

Just before darkness set in was the last view I had of Tristan da Cunha with the little stream of smoke still coming from the smoldering remains of their volcano. I seriously doubt if I will ever again see this island.

Later, I read in the newspapers that all the inhabitants who fled the island during the eruption had returned there. Then sometime last year I read that many of them wanted to leave again. I suppose their sample of modern civilization had spoiled them. As for myself, I don't see how anyone would ever want to live on that cold, damp, bleak patch of rocks sticking up out of the cold South Atlantic in the first place. I don't think the wind ever stops blowing, and it seems cold all the time, even in their summertime.

... W4BPD

Climbing the Novice Ladder

Part IX: Happy day! Joe and Judy are licensed!

The month just passed had been full of activity for Judy and Joe. School had commenced for both and Joe had begun his employment at the supermarket on Saturdays. Judy's evenings had been spent mostly between school homework and familiarizing herself with the ham bands through listen-

Their novice licenses arrived simultaneously!

ing on her little CONAR receiver. She had experienced greatly improved reception on all bands since hanging a good 80 meter dipole. As she gained experience in tuning adjustments, her code ability gradually improved through her many hours of listening. She began to pull in some real DX stations occasionally . . . VK's, JA's, ZL's and a few G and D stations she was able to identify. Judy was already on her way to becoming an accomplished novice operator even before she could legally put her transmitter on the air.

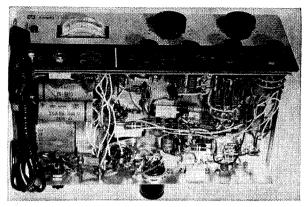
Joe too, had not been idle. He had given up his evening paper route when his new job at the market had materialized. Rushing home from school each day he would first accomplish his home work assignment and then make for his little basement corner where his father had installed a small work bench. Progress on his Knight-Kit T-60 transmitter assembly was good and he was but a few days away from an initial test by Larry with a final check by FN. Larry had been a frequent drop-in visitor while Joe was working on the rig and had given him a number of hints and tips which helped ease the construction path. Larry's college would not commence for three more weeks, so he wasn't yet burdened with studies and could devote considerable time to Joe.

And then, to climax the month's activities, both Judy and Joes' formal official licenses as novice class amateurs, complete with call letters, arrived simultaneously! Excited rejoicing and an overwhelming eagerness to get on the air electrified the atmosphere at both of their homes. As the licenses had arrived on a Thursday, Judy was forced to wait until Saturday when FN

had promised to come over and help her get set up to transmit. As much of the initial installation, tune-up and adjustment procedures would necessarily be repeated by Joe when he finished his transmitter, he was invited to Judy's place to participate in her inauguration into the realm of transmitting hams. Completion of Joe's rig had been delayed because, in his haste to complete it, he had made a couple of significant wiring errors which Larry had caught and pointed out to him. The instruction book had been perfectly clear, but in his eager haste, Joe had been a bit careless; he was now engaged in rectifying the errors.

On the appointed Saturday morning FN, Judy and Joe gathered in Judy's shack. This had originally been just a 'catch-all' storage closet on the second floor near her bedroom. Her mother had been cooperative in removing such odds and ends as had been stored there, relegating them to the attic. Judy's Dad, Tom, had done a bit of patch-work on the closet walls and built a neat little operating desk at one end and Judy had painted the interior. Fortunately the closet contained a good sized window and Tom had provided additional lights and electrical outlets; Judy came up with a real neat shack . . . really 'groovy' as Joe termed it.

FN opened the session with, "Well, kids, there isn't much to do in here now. Your Dad has the coax feeder to the antenna run in and you've already got a ground wire to the cold water pipe in the bathroom. Tom, I'm glad to see that you provided a couple of outlets right here at the back of the operating table; won't have to drape straggling lamp cord about the room. You have your transmitter sitting in just about the right spot for you Judy; you're right handed so the transmitter should be at the right as you have it. This will leave your other hand free to manipulate the receiver for minor adjustments when you're copying someone. You won't need to touch the transmitter ordinarily while you're working another station, so your right hand will be free for keying." "OK Gramps . . . here's the coax feeder . . . I already have it skinned ... let's get going, shall we?" Judy cut in. Both Tom and FN laughed and FN said, "Goodness girl, don't rush me; let me get my trusty briar fired up first; never could make a good connection without a nicely drawing pipe". Filling and lighting his pipe took but seconds and then FN removed the



Joe's little T-60 rig in the final wiring stages. Later FN showed him how to lace and cable the loose wiring into a neat harness.

coax from its' connection to the receiver and said, "Now where's the little knife switch I told you to get for the antenna change-over Judy?". "Right here Gramps," she replied, opening a drawer which Tom had thoughtfully built in to the desk. "And now Tom, a couple of round-head wood screws . . . about #6, half inch long will do." "Yep, got lots of 'em in the shop Dad; I'll grab a couple . . . anything else we'll need?". "Yeah, bring a screw-driver too unless your thumb-nail is that good," FN chuckled. "I brought my little pocket tool kit but I left the screw driver on my bench for some reason".

Tom returned in a few minutes and FN then proceeded to fasten the little single pole, double throw porcelain base knife switch to the table about midway between the transmitter and receiver. He connected the coax from the antenna to the center blade of the switch and the pigtailed braid to Judy's ground wire. "Now", he said, "we had several feet of coax left from the antenna installation didn't we?" Again Judy pulled open the drawer and said, "About six feet Gramps; I coiled it up and saved it to start my 'junk box'." "Good girl Judy, that's plenty. Now suppose you kids cut a couple of pieces of coax to reach from the transmitter and receiver to the switch, skin both ends and connect them up. While you're about it, better move your key over closer to the transmitter Judy . . . you've mounted it for code practice so that the switch now crowds it . . . about six inches to the right will be better. Meanwhile, Tom and I will go down and see if we can wheedle a cup of coffee from your ma."

When FN and Tom returned to the shack, the coax lines were in and FN complimented the youngsters for remembering to connect



... You can't drive a car with an empty gas tank . . . the coax shield braid to the ground screws on the equipment and to the ground wire at the switch. Judy was making up a cord and plug for the key jack on the transmitter. This finished, she handed it to Joe who connected the open ends to the key, then plugged the cord into the jack. "That does it, kids," FN announced, "we're ready for the first blast. Plug in the transmitter power cord Judy . . . good; I'm glad to see you checked the panel switch first to be sure it was in the 'off' position; thats' one little lesson that got through to you, eh?". "Yes Gramps, I've been doing that with my receiver since you told us about playing it safe so it's just about a habit now." "All right" said FN, throw your antenna switch to the 'transmit' side now and turn on the power at the transmitter switch. Give the tubes a minute to warm up . . . that should do it. Now with the meter switch on 'plate' press the key Judy and watch the meter. If the needle hits the pin at miximum, and no doubt it will, quickly turn the final amplifier dial to find the 'dip' spot; you've left the load control at minimum which is correct

at this time. Remember to tune the final quickly to save the meter and maybe a tube. Ready? Go to it!" This wasn't too difficult; Judy had been industriously reading the adjustment procedure section of her instruction book ever since her license came but to her surprise, the meter showed no reading! "Gramps, what did I do wrong?" she anxiously inquired. FN chuckled as he said, "It's not what you did wrong, Judy, it's what you didn't do that made the difference! I wondered if either of you would catch it but guess you're too excited. How about plugging a crystal into its' socket so the final amplifier gets something to work with; you can't drive a car with an empty gas tank you know . . . you did pick up a crystal didn't you?" "Yep, got one at Jim Turners . . . 3720 kilohertz . . . that OK?" and again she dipped into the drawer and brought forth a conventional mounted crystal in a standard amateur holder. "That's fine Judy, it's almost the center of the band and a safe distance from either edge; anybody else in town with the same frequency?" "Only one FN," Joe chimed in, "we checked at the club and one of the fellows over on the west side has 3720, but he's taken his General class exam and hopes to have his license soon and then he says he'll sell me his novice crystal and Judy and I can work together on the same frequency. I'm going to buy another crystal too so I won't bother Judy when she's working other stations". "OK" said FN, "you youngsters seem to have things pretty much under control then. Now Judy, plug in the crystal and hit the key and lets' see what happens. Now you get a full scale reading . . . that's it, dip the final and you get 40 milliamps. Move your loading adjustment up a couple of points then dip your final again . . . there, you get 70 mils now . . . give it a couple more points and do again. Whoops . . . that hits 115 at the dip; better keep it at about 100 to prevent overload. Go back one point on the loading knob and dip the final once again; thats' better . . . just a hair over 100 . . . leave it at that. Now flip your meter switch to 'grid'; press your key now; what have we got? Three mils . . . you can use a bit more drive so tune your oscillator dial a bit . . . let's see if we can bring the meter to about 4. Now it peaks at a little over 4. Put the meter switch back on 'plate' and hit the key again. Now you get about 108 on the dip; go back just a bit on the loading

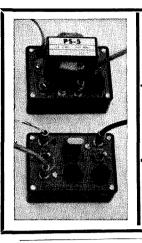
dial and dip the final again . . . that's good ... 102 now and you're all set to pound out a 'CQ' . . . feel up to it?" "Oh, gosh Gramps, do I have to? I'm kinda shaky and maybe I can't make it". "You're the operator Judy, you might as well get used to it . . . you don't want Joe to make the first call do you?" "Hey FN, not me," Joe broke in, "I think I'm even shakier than she is". Both FN and Tom gave out with hearty laughs following which FN said, "All right, don't start out with a 'CQ' call then Judy; simply make a few 'V's', send the word 'test' a couple of times, follow it with a single 'de' and your call letters about twice, then an AR to finish off. Want to write that down so you can follow it? Nobody should call you after that and it will give you a chance to get the feel of putting your signal on the air." Judy wrote it down as FN dictated and then, not exactly in fear and trembling, but with plenty of misgiving, she rather haltingly made the suggested sequence of characters, stumbling a bit on one or two but reasonably readable. "Joe" said FN, "you want to try the same thing?" "Not this time FN," replied Joe, "I think I'll wait till I get my own rig on the air . . . then I won't have to sweat it out twice!" "OK son," laughed FN, "as you like. Judy, go ahead and repeat your test call once more . . . fine . . .you're better already. Now make the 'CQ' call . . . I've written the letters down here for you so you won't have to hesitate. You'll get used to the conventional method for such calls after a few trials then you'll find it automatic". "Well" shrugged Judy, "no time like the present I guess so . . . here goes!" Rather haltingly at the start, she gained confidence as she proceeded and wound up with her call and a 'K' in pretty good style. "Throw your antenna switch to the left Judy and do a little tuning on your receiver. There's a signal . . . hold it; no, he's already working someone. Try another CQ". Again there was no reply. As Judy appeared a bit crestfallen, FN reassured her with, "You won't get an answer every time you call CQ Judy . . . sometimes it takes a number of calls before someone runs across you. Let's try a different approach: tune slowly around your own frequency on your receiver and see if you can find someone who is sending a CQ; maybe you can raise him". Sure enough, about 3 kHz removed from her own frequency, Judy tuned in a reasonably strong signal, slowly sent

as befitted a novice and making rather good character formation. Concentrating with furrowed brow, she copied his call correctly after two false starts; fortunately he repeated it several more times then signed off with AR and 'K'.

"Go ahead Judy, give him a call" Joe broke in; gosh, I hope my first chance will be with a guy sending as good as that; I can read every letter he makes". Judy looked grim but determined and threw her antenna switch to the 'transmit' side and carefully spelled out the other stations' call several times, 'de' once and followed with her own call a number of times ending with 'K'. Back came the antenna switch and her hand automatically reached for the receiver dial knob; she might need to trim his signal slightly if he came back! And . . . he did! Gripping her pencil tightly Judy carefully wrote, letter for letter as the other



"Go ahead Judy, give him a call."



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station gave her the conventional signal report, his location and his name. FN copied with her and filled her in on two of the signal report figures; she was still a bit timid on the numerals. Reminding her to acknowledge, FN said, "Give him a couple of R's, tell him his signal is RST579, that your OTH is Columbus, Ohio and your name is Judy, then let him take it". Judys' confidence increased as she continued her QSO and she managed nearly ten minutes with him with Joe avidly listening to the speaker while Tom and FN went downstairs for another cup of coffee. "Better to let them wrestle it out now Tom; Judy has caught on and they won't feel so nervous if we're not standing over them." "Right you are Dad." said Tom with a laugh, "Judy has been fit to be tied the last couple of days.

"They don't make receivers as good as they used to."

She was so anxious to start going the day her license came but we put our foot down and told her that her school work came first and that she would have to wait until Saturday, so this has been a really gala occasion for her". "Yeah", FN replied, "I've seen a lot of beginners and her reactions are comletely normal . . . they all run in the same pattern; kinda like taking the wheel of the family car for the first time I 'spose".

When the men returned upstairs, FN was a bit surprised to find Judy entering all details of the contact in the little log book she had provided for herself. "Well Judy," said FN, "I was about to remind you that you had to make log entries for every transmission but I see you didn't need reminding . . . good for you." "Sure thing Gramps . . . I'm all set up now but I'm sorry to say that Joe had to give me a nudge on the logging. I was full of the other guy's chatter and would have forgotten if Joe hadn't brought it up. That fellow was in Cleveland Gramps, and I guess my signal was as good there as his was here; at least he said 'solid cpy' which I think means 'solid copy'. His name was Fred and his weather is about the same as ours. Thats' not really 'DX' but it's a start; I'm going to go right after a WAS certificate . . . you think I can work all states with this rig Gramps?". "Sure thing, Judy; pick the right band at the right time of day and go to it . . . you'll make it in time. States close by you'll work on 80, those several hundred miles from here will be better on 40 and the most distant states will probably come through on 15. We'll all get together on some of the finesse of working out next time we have a session. Anyway, you're on the air now Judy . . . congratulations."

Turning to Joe, FN inquired, "Well son,

you see how its' done now; when do you think you'll finish that T-60 kit you're working on so you too can get on the air and work Judy and others?" "I'll bet it won't take me more than a couple of days now FN; I'm supposed to go on some kind of pienie tomorrow but I'm not going; I'd rather spend Sunday working on the rig and then Larry can check it for me and maybe I can even get on the air Sunday evening. The club gang and Larry helped me get up a good antenna a couple of weeks ago and it sure made a difference in my received signals. I've got the crystal, key, antenna switch and everything for the transmitter now so you can bet I'll get that finished in short order". "Tell you what we'll do kids, if its' OK all around" FN replied, "suppose you come out to my place next Saturday and we'll have a nice talk about clubs and organizations to which you can now belong, magazines and books most suitable for the novice and we can also discuss proper operating procedures to get you the best results and put you on the road toward your General class ticket. As you know, you can be a novice for only a year, and then you must pass the General class exam or give up ham radio until you do, so you'll have to keep right on with your code practice and book learnin'. The code will not be too bad as you'll be using it every day on the air but don't neglect your books because the theory exam for General is considerably broader in scope than was your novice. So, how about it . . . want to come out next Saturday?" "You bet," they chorused, "we'll need all that kind of help we can get".

Before the gathering broke up, Tom chimed in with, "Remember Dad, I'm coming out with them; this doggone stuff has gotten under my hide and I can't let these kids beat me out. I'm reading both the books and Judy has been giving me a lot of code practice so I'm getting there". "Fine Tom," returned FN, "come on out . . we'll make a ham of you yet".

. . W7OE

Next Month: A discussion of proper operating techniques and related tricks of the trade, recommendations for suitable magazines and other literature, and a general summing up, embarking Judy and Joe on the road to the General Class and firing Tom with increased enthusiasm to become a novice and catch up with the kids.



oscillator/monitor

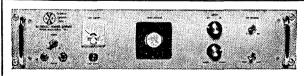
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river that goes through the center of town and then take out water down river for drinking. I saw cows dropping in a small stream and people washing clothes and drinking just below. Oh well, they haven't invented backhouses here yet, much less indoor plumbing. Ed gets his water from the U.S. Embassy.

I watched the streetside merchants weigh out fruit and vegetables on scales with stones for the balance. Everything is basic and primitive here. I was amazed to find that a nice sheep lined coat cost only about \$6. The wages are low, with a policeman making about \$20 a month and an airline pilot about \$80 a month. No wonder I was able to find a beautiful wolf rug made up of six fine pelts for only \$30!



In Kabul. Prices are really low—this sheep-lined coat was only \$6.

There was a note at the hotel from Jim W5PYI, who had gone on ahead of me to Kabul a couple days earlier. He'd found the place dull and gone on to New Delhi.

Back at Ed's home we went almost immediately to the ham shack, a small building out in back of the house. Ed had a Swan 350 and a Swiss Quad up about 20 feet. He claimed it worked just fine. He explained that since there is no licensing authority set up in Afghanistan that I could go ahead and use YA1NSD, or any other call I liked. I sat there the rest of the afternoon and evening filling my log with contacts and talking to friends.

Although there is much to be said for the fun of working out with low power,



Ed Daniels, YAIDAN.

I can't help but notice that the further I get from the U.S. the more a few strong signals really stand out. Over here in Kabul there would be few U.S. stations to talk with if it were not for the fellows with the kilowatts and big beams. They are the only ones you hear except when conditions are just right. Chaps like W20NV and WA2SFP come through no matter what the conditions are. I had great trouble in getting their attention with my low power, which was frustrating. I'm used to the way it is back home at W2NSD/1 where I know that my signal is getting through and will be heard.

We had dinner out that night with Fred Vogel YA1FV and his family at the king's summer palace, which has been converted into a night club. The tab came to about a dollar per person.

After dinner I went back on the air again and finally hooked WA6BSO (now W1DTY) operating my home station. We talked for a good half hour with good signals both ways.

The next day Ed piled his family, me and Mrs. Vogel and daughter Kathi into his

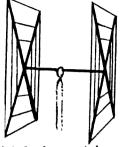


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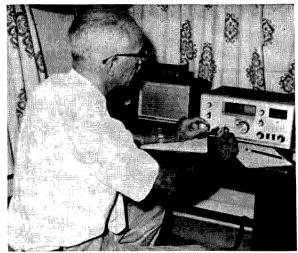
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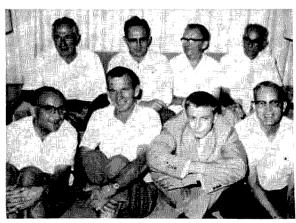
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Fred Vogel, YAIFV.

microbus and we were off to a small mountaintop village a few miles away. The houses are made of mud bricks, as they are in all of Afghanistan. The most amazing thing was the town water supply. They've dug a tunnel from a nearby mountain which feeds a stream through the valley and up into a reservoir on the top of the hill with the town on it. The water is fed to the town through ditches for a few hours a day, a couple hours through one ditch and then a couple hours through another, etc.

Afghanistan is right next to Russia and you can see the influence everywhere. All of the taxis in Kabul are the Russian "Moscow" car and all are, as far as I could see, in the last stages of disrepair. The roads were built by Russians with Afghan slave labor, as were many of the buildings. Right then they were working on a Russian college which will be staffed with Russian teachers. The Americans, on the other hand, get all



Left to right, front row: Pit YAIBW, Ed YAIDAN, Wolf YA5RG, Charlie YAIEXZ. Back row: Ken YAIKC, Helmut YAIHC, Ali YAIAN and Fred YAIFV.

their workers on the open market and pay them well. USAID is here and doing well, as is the Peace Corps. The Americans live in their own section of town in houses built out of mud bricks, but over the mud is a layer of plaster and paint and they look very nice indeed.

In the evening we visited YA1FV and I met just about the entire ham population of Afghanistan. They talked over the local situation, which is delicate. The government will not license anyone and they are all afraid that something will come up which will put a lid on their operation, which is done with tacit consent. You can be sure that they police themselves very carefully.

The airline schedules were all mixed up and my plane had been delayed a day, so I had one more day in Kabul than I expected. I spent most of it on the air working as many stations as I could. My short visit netted me 46 countries and I surely could have made it a hundred if I had tried at all. Ed and I went downtown and I bought another jacket, fox lined and a fox rug. These things are so reasonable that it is hard to pass them up, even for a stinge like me.

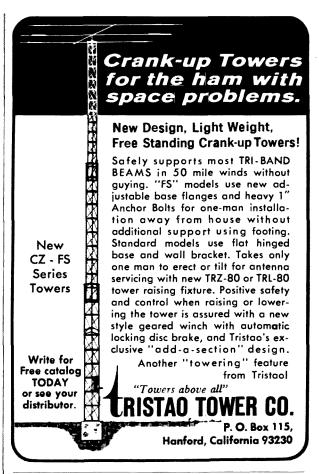
When I arrived at Kabul someone said, "Welcome to the land of the soft stool." He was right. Ed and I both picked up a mild case of dysentery. The Americans living there have a difficult time. They have to watch out for the water, fruit, vegetables and almost everything else. Even with the utmost care they have a bout every now and then, never seeming to get immune to it. Funny, but when you travel, particularly in Asia, your digestion becomes a major topic of interest and discussion.

If I thought I had troubles in Kabul, I should have known what was going to hit me in Delhi. The plane left for New Delhi the next morning, only one day and a half hour late, carrying me to my meeting with Raju and Karnik. And I only had to bribe the chap at the airport 100 Afs to get my cameras out of the country.

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Viet Nam

Last year Fortune magazine did some cost accounting on the war in Viet Nam. I remember when there was considerable worry in the press, a few years back, because the U.S. was spending \$1,000,000 a day there. Last year we were spending about \$60,000,000 a day. It's probably up around \$75 million by now, reaching for \$100 million a day.

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year is just under \$2 million a day.

I've been mulling this thing over.

Back during WWII, I read the figures on the cost of the war and wondered what the world might be like if we could put all that investment into the building of countries instead of tearing them apart. We poured millions of dollars of bombs and equipment, not to mention lives, into dozens of Pacific islands. With this investment we could have built whole cities . . . whole countries.

Further thought . . . if we had been investing in building cities and countries perhaps the war would never have happened?

Now, to get back to the present, or close to it. Last year I made a little trip through Asia, visiting Burma, Thailand, Singapore, Australia, and the Pacific islands. I talked a great deal with friends in these places about our Viet Nam war. I found the people rather better informed than most Americans, and, in general, in support of our goals.

The situation is serious when you get out your map of Asia and take a thoughtful look at it. Right there in the middle is China. If China is going to open up its central and western areas, it must have access to the south. And they are getting it. In the west they have done a fine job of opening things up for themselves in Pakistan. This country is now very pro-Chinese and anti-U.S.A. They tried to open things up into India, but the U.S. threatened to come in and help and they gave up. They did take over Tibet.

Central China is ready to open up now too. In case you didn't know, Burma is a communist country today. I'll tell you more about my visit there in due time, but Burma is one of the great untold stories in the world today. I read a lot and I have seen nothing about the fantastic situation there. Burma is open to the Chinese right now.

Thailand is in a fighting war against the communists . . . Cambodia has been largely taken over . . . so what is left? Mainly our little holding action in Viet Nam. If we pull out that will be the end of southeast Asia . . . and probably India too. How can they hold out when they are surrounded? The Indian government is weak and disorganized. It would not be difficult for the communists to push in and take over there.

So what's wrong with letting them have Asia?

Well, when would you try to stop them? It is like the situation we had with Hitler.

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He took a little bit here and a little bit there. gradually ending up with everything. The communists are doing a fine job of getting little wars started here and there. They are hard at work in Africa. Right now they've got a nice little thing going in Somalia and upper Kenya, with Sudan and Ethiopia all tied up trying to keep things from getting out of hand. Supplies are pouring in from China and Russia to the Shifta in Somalia.

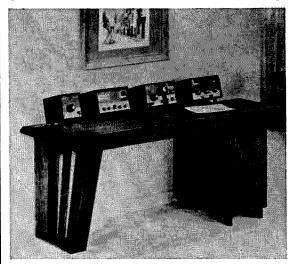
Once they win southeast Asia completely, then India, Afghanistan will be a pushover, as will be the other Arab countries . . . Iran, Iraq, Syria, etc., where they already have a heavy foothold. Then comes Africa . . . and they have a good foothold in there too now. They're working industrially in Central America, South America . . . when do we worry?

Now let me tie my ideas together for you. We are, as far as I can see, faced with expanding communism in many areas. Right now the area that is critical is Viet Nam. The war we are fighting there is miserable and expensive. I just wonder if there isn't a way that we could pursue peace in Viet Nam instead of war.

It is difficult to escape noticing that the U.S. military has some rather inflexible ideas on how to win a war. This is not strange, when you consider the whole system that provides our military leaders. The development of officers in our armed forces is a weeding-out process. Those officers that are trouble-makers don't get promoted and eventually drop out for something more rewarding. As a general rule then we find our generals and admirals are made up of men who have spent a lifetime not causing trouble. They usually live by the book. Few men can go through the years of indoctrination and then change when they come out on top. This is why, to my mind, we have found the navy sticking by their battleships and fighting carriers and why the army generals fought off air power for so many vears.

Right now this means that the military who are running our war are working in deeply dredged channels of thought on how wars are to be fought and won. They have been changing slowly and meeting the situations in Viet Nam with new solutions, but I suspect that many of these new solutions were brought into play only after repeated disasters with the old ways of doing things. Certainly a close reading of the war reports

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are full of this sort of thing.

I just wonder how much brainstorming has gone into the whole overall idea of trying to achieve our ends in Viet Nam? From the figures I've given, we can see that our present course is largely a military solution . . . \$75 million a day for the war and \$2 million a day for economic aid.

What would be the result if we took a few of those \$75 million spent every day and used them a little differently? Like for building instead of destruction? Suppose we shipped over a \$2 million dollar factory to make prefab native houses. Suppose we sent over the sawmills to make the lumber for the prefab factory? And how about a factory for furniture to furnish these houses? Then we might put in a factory to make simple tractors for working the land. And even more important, a factory to make small cars, possibly something like an overgrown go-kart, which could sell for a very low price.

And what would we do with all this stuff pouring out of the factories? How about giving a house and furnishings plus a job to everyone who asks for it? The houses could be set up in Levittown-like groups. Tractors could be available for each so many houses to farm nearby lands. From there on they would have to work to buy food and buy cars and other goodies. With something like this going on I wonder how long it would take before we would have to set up a toll booth on the Ho Chi Minh trail to register the flood of communists coming down from the north to get in on the good life?

It looks to me as if we might be able to build a new country over there along the lines that have worked here, for a fraction of the money we are now pouring into it. Plus we would save a lot of lives and produce a strong new country. Not to mention the effect this would have on all of the other countries that are falling into the communist camp. This should solve the pacification of villages problem, and probably even the political problems would solve themselves.

The U.S. would retain ownership of the industries at first, then set the larger ones up with stock which could be bought by the people. The stockholders could then insist on their own management of the companies, if they thought this would bring them more returns.

The future of any country depends heavily on the schools it has. We would do well to build schools into each of our new communities and staff them with American teachers. Scholarships for brighter students to come to U.S. colleges would cost us little, comparatively. We need to aim for Viet Namese teachers for the next generation . . . as well as Viet Namese engineers, artists, and businessmen.

There you have it, the Green solution to the war. This should be acceptable to those who think we must win in Viet Nam and also to those who think we shouldn't be fighting there. It should be of interest to those who don't like the idea of throwing away \$75 million every day, including Sunday. And that is what it is, throwing it away.

No doubt you've thought of several reasons why my program would get into trouble. I wonder if there are really any unsolvable problems involved? . . . Wayne

The View From Here

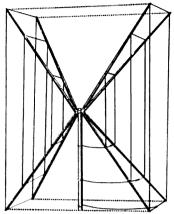
the "Basic" license because they feel the word "novice" has some bad connotations. I can't see why. After all, isn't the General class license the basic license? If it isn't now, it certainly will be if and when incentive licensing goes through. Right now it appears that incentive licensing isn't an if anymore, but a when.

The Novice licensee is a novice, or a beginner, and the name of the license seems most appropriate. In some respects the title novice is better than the beginner class issued in some countries. The word beginner seems to indicate that the individual is just beginning. Although the Novice is a beginner in many respects, he has to have a rudimentary knowledge of radio theory and Morse code, so he is slightly beyond the beginner stage.

Although it doesn't appear to me that the name of the license would have very much effect on the number of new Novice licensees and the number that go on to higher class licenses, a longer license period and phone privileges on ten meters would offer a great deal. The Novice license was intended as an introduction to ham radio, but it doesn't seem to me that that is what the present Novice class offers. An extended license period and limited high-frequency phone privileges would give these new amateurs a chance to see what ham radio is really like. Hopefully, more of them would go on to obtain full operating privileges.

. . . Jim Fisk W1DTY

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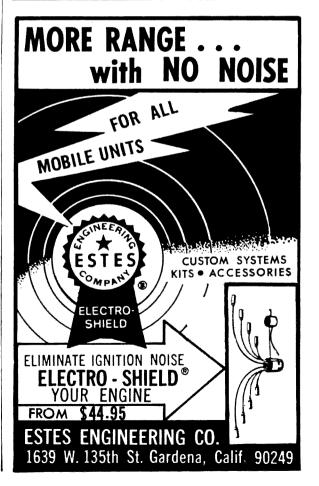


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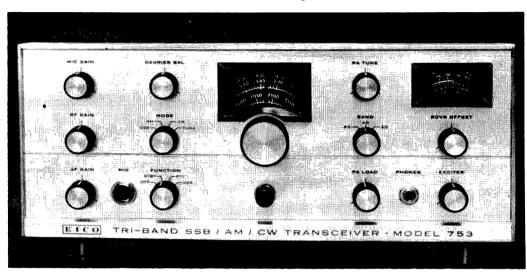
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One thing I hate is the use of super \$64 words as a means of attracting attention. When you have used up all of the extravagant phrases, what is left to describe a truly good deal? Once in a long while, however, a value does come along which is relatively outstanding and which causes me some concern because I don't want to turn my principles around in the enthusiasm which I rarely feel. I am talking, of course, about the 753 Eico kit. First, it is good looking. The gals will appreciate that. Second, it is not exactly a naked transceiver. It has incremental tuning, enabling you to listen up to 5 kc either side of your signal, and it has vox, and built-in high level ALC. It has two speed tuning, either 6 to 1 or 30 to 1 and this is nice when you are trying to make the other fellow sound just perfect. It has a triode detector for AM. It gives you full band coverage on 80, 40 and 20 and it provides grid block break-in CW keying. These are the kinds of features found normally on the highest priced transceivers. The 753 has a normal power input of 200 watts PEP; of 100 watts AM. Its output is a pi and will match 40 to 80 ohms. Its thermal shift is less than 400 cycles after a 10 minute warmup, and its sensitivity is better than 1 my for 10dlb signal-to-noise. In short, this is a darn good design, especially since the factory has improved the VFO and made it Solid State.

Our "Meat and Potatoes" power supply kit, described in recent ads, has been going over real big. There is really no comparison. This kit weighs 45 pounds and will make any standard transceiver sound better with its superior regulation and higher dynamic range. The MP supply is a kit of our own development and we have been selling lots of them. While our stocks last we will provide the Eico 753 and our MP supply for only \$189.95, F.O.B. Harvard. We will ship via Railway Express or truck. The Eico will weigh about 30 pounds and the MP supply 45, so you can figure your transportation costs from this. Remember that this unit will drive any standard linear and that by itself, with the addition only of an antenna, a mike or key, you will have a complete station, suitable for AM, CW or Sideband. For those interested in the original Eico power supply kits, we have these too, either the DC or the AC. By themselves they sell for \$59.95. If you want the Eico 753 by itself, the price on this is \$149.95. The best value, of course, is the combination we spoke of first.

With the continuing shrinkage of the dollar ever present, where and when can you expect to find this kind of a deal again? This would be fine for mobile operation if you already have a rig and don't forget that this set makes an excellent beginner's station. If you are prone to want to break into this ham radio game, here is sound value.

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What's New for You?

Have you found a simple new circuit, or new semiconductor or other component, that has been useful in your building? There are plenty of hams who would like to find out about it. Why not send in a short note for this column and we'll publicize it and make it available to all the other experimenters who read 73. We're also looking for technical comments on 73 articles-corrections, modifications, or compliments—and newly available surplus, technical nets and meetings, new records and other information that's likely to be interesting to the technicallyminded ham. Please keep the comments short, and send them soon before someone beats you. Send to Paul Franson WA1CCH, 38 Heritage Road, Acton, Massachusetts 01720.

Cheap VHF FET

The 2N3819 FET has been used in many projects in 73. It's an excellent general purpose N-channel FET made by Texas Instruments. It can be used from dc to 300 MHz. The former price was \$3.75—now it's 90c, from Allied as well as many others. Here's the perfect FET to transistorize all those old tube projects. We've heard of people converting command sets to use FET's by simply replacing the tubes and a few resistors, but have no details yet.

Tunnel Diode for \$1

General Electric (and others) have recently developed new techniques for mass-producing tunnel diodes at low cost. TD's have been around for a long time, but haven't been used too much because of the former high prices and the peculiarities of the devices. Now TD's are being used more and more. They are used in a number of UHF-TV converters (incidentally, the Japanese call tunnel diodes Esaki diodes, after the Japanese who invented them), and in many

computer applications. Tunnel diodes use little power, can furnish high gain and low noise, and are very small. One TD can act as an rf amplifier, an oscillator, and a mixer at once, but you have to make sure that the proper function is happening at the proper frequency. TD's overload easily and can't furnish much power. They also are difficult to cascade and tend to take off at unsuspected frequencies. Nevertheless, they are interesting devices with many uses and more ham experimenting and articles on tunnel diodes are needed. Both GE and RCA publish inexpensive books on TD's and in addition, GE has many excellent TD application notes. If you want to experiment, the GE TD710-719 are \$1.05 to \$1.62.

Laboratory Power Supply Questions

Hank Olson W6GXN always writes interesting articles, but perhaps his Laboratory Power Supply on page 38 in last December's 73 turned out to be a little too challenging—through no fault of his. The two zener diodes (CR7) are shown correctly on the schematic, but they're reversed on the parts layout. Likewise, the 560 k Ω resistor next to them on the layout should be 560 Ω . There seems to be a little confusion about the diodes mentioned for CR5 and CR6. The Hoffman HB5 is no longer available and the Fairchild FD135 (not FD1135 as stated) is also rare. It doesn't matter too much since almost any silicon junction diode (1N457, for example) will do.

Finding Your Two-Meter Frequency

Bill Richerson WA6VGR has come up with a simple way to multiply 8-MHz crystal frequencies by 18 to get the two-meter frequency they'll produce. Simply double the frequency in kilohertz on the crystal, then subtract that number from double the frequency plus a zero. For example, to find the 18th harmonic of 8127 kHz, double 8127,



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giving 16254. Then add a zero to 16254 (162540). Subtract 16254 from 162540, leaving 146.186 MHz. Very quick.

Free 88-mH Toroids

You can't beat this offer: Art Brothers W7NVY, president of the Silver Beehive Telephone Company in Grouse Creek, Utah 84313, has offered two 88-mH toroid telephone loading coils of the type used in many RTTY converters and audio filters free to those who write him and request them. Include 25c for postage and handling, and your QSL card. Though he has a pretty good stock available, the offer is limited, of course. Send now before he runs out.

Transistor circuits - again

Watch out for those complimentary circuits in Fig. 20 and 21 of the 73 *Transistor Circuits* in the March issue. In both cases the collector and emitter of Q3 are reversed; The collector should be grounded—not the emitter.

Teletype Flip

Frank Dick WA9JWL has suggested a small change in W6AYZ's AFSK converter in the January issue that helps make it more useful for FSK on the high frequency bands. It allows the received signal to be turned upside down at the receiving end. All that is necessary is a DPDT polarity-reversing switch added between the 0.02 µF capacitors connected to the hot ends of L1 and L2, and the diode multipliers. Frank also mentions that he is very happy with the way the unit performs.

I Watt IC

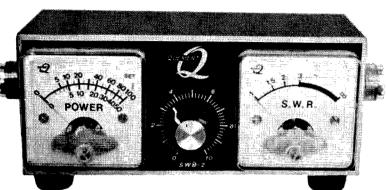
Packaged audio amplifiers available from Lafayette and others are very popular for many ham projects. They provide high gain, are small, and take little power. They are also available in many varieties with power output from 100 mW to 5 or 10 watts, and cost only \$3 to \$10. I've used a number of them as modulators for small transmitters, audio amplifiers for simple transceivers or receivers, and most of all, for testing. However, new developments in integrated circuits have just about made them obsolete. For example, the new General Electric PA222 integrated circuit audio amplifier (\$3.70 for one), is a tiny (less than 1 inch by ¼ inch) device that will put out 1 watt of audio at 24 V. Its frequency response is within ±3 dB from 55 to 15,000 Hz with 1 watt

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of output, distortion is low, sensitivity for 1 W output is only 75 mV, gain is 72 dB, input impedance 40 k Ω and efficiency is about 50%. It requires a heat sink, which is attached to a small tab sticking out of the end of the device. External circuitry isn't very complicated, either. Now, about that miniature receiver you were going to build . . .

Is Aries Dead?

The death of Ewell Carter WA6ZAIJ, originator and director of Aries, has caused severe problems for the group. Ewell had done much of the work and kept a record of it in a form that isn't very useful to others. It now appears that the satellite project may have to be shelved. If anyone might be interested in helping out, please contact Bob Kolb WA6SXC, 1300 W. Oak, Fullerton, California.

Keeping Kids off Your Tower

A ham can be sued for liability if a child climbs his tower and falls off or is otherwise hurt. This is true even if the child is trespassing on the ham's property. Bob Sull WB2ZQI has suggested a simple way to discourage unwanted climbing. He wraps the lower part of his tower with chicken wire and fastens it in place with wire. This prevents the kids from climbing, yet is easy to remove when necessary.

What Transistor to Use?

An unidentified author is Static, the bulletin of the North Penn ARC in Philadelphia mentions that he has just about solved the question of what transistor to use by standardizing on the 2N706 NPN transistor (available in surplus for almost nothing or new as the plastic-cased Motorola MPS706 for 45c) and the PNP 2N3638 (Fairchild) or MPS3638 (Motorola) for 46c. Both are excellent silicon transistors with a dissipation of about 200 mW. The 706 is useful to at least 100 MHz and the 3638 to about 10. The Static author mentions that he has built a complete 10-meter superhet including audio output with 2N706's and that almost all of the transistor circuits in the April 73 circuits book can be built with these two transistors.

... Paul WA1CCH



Knight-Kit Solid-State RF Signal Generator Kit



If you have been struggling with an old tube-type signal generator or using a unit that is poorly calibrated, you can step up to an excellent solid-state unit with the new Knight-Kit KG-686. This generator covers from 100 kHz to 54 MHz with an accuracy of \pm 1.5% on all bands. When the built-in 100 kHz/1 MHz crystal calibrator is used, usable calibration within 0.1% can be easily obtained. A built-in detector-amplifier-speaker gives zero beats from the crystal calibrator.

The built-in meter shows either rf carrier or modulation level and the individually shielded attenuator switches provide 21 output levels to -96 dB. 0 dB equals 100,000 μ V into 50 ohms and calibrated outputs as low as -106 dB $(0.5~\mu\text{V})$ may be obtained. Fine control with the meter covers -10 to +2 dB calibrated on the meter. The maximum calibrated output into a 50-ohm load up to 30 MHz is $120,000~\mu\text{V},~\pm2$ dB. The internal modulation is 400~Hz with metered depth of 50% up to 30 MHz. Provisions are made for external modulation-1~Vrms will provide 50% modulation at 400~Hz.

The KG-686 features a solid-state floatingtype chassis-isolated oscillator with tunable L and C on every band for accurate tracking. The 4" metal dial has two alternating colors for easy reading and the 6:1 vernier drive with anti-backlash permits you to set it right on the money. The chassis has been carefully layed out and generous copper shielding assures minimum radiated leakage. The power supply is regulated for maximum output stability.

The KG-686 kit is furnished with a BNC output jack, mated terminated cable, solder, detailed assembly manual and operators manual—everything you need. Available for \$95.00 from Allied Radio Corporation, 100 N. Western Avenue, Chicago, Illinois 60680.

Ameco Preamplifier

The new Ameco PT preamplifier is a continuously tuning unit that is specifically designed for use with a transceiver. It improves sensitivity and signal-to-noise ratio while receiving and bypasses itself while the transceiver is transmitting. In addition, it may be used to feed a second receiver and automatically mutes it when transmitting. It also improves immunity to transceiver front-end overload by use of its built-in attenuator. All of this without any modifications to the transceiver.

The PT preamplifier has been found to be especially effective on 10 and 15 meters when used with transceivers using a pi network in the output. Most receivers of this type begin to suffer a noticeable decrease in sensitivity on 15 meters and especially on ten. In addition, the inclusion of 6 meters in its tuning range makes it usable with those second receivers having a 6-meter range. \$49.95 from Ameco Equipment Corporation, U. S. Highway 1, North, P.O. Box 6527, Raleigh, North Carolina 27608.

Gonset Two-Meter Linear



A new linear amplifier with a built-in solid-state power supply for mobile use with a GSB-2 SSB Communicator or similar exciter has been announced by Gonset. Ruggedized for mobile use, it is completely self-contained, and derives all operating voltages

from the 12 Vdc primary electrical system of the vehicle.

The Gonset "Comtron" mobile linear covers the entire two-meter band including MARS and CAP frequencies and may be operated in any mode, AM, CW, FM or SSB. A blower provides ample cooling for the heat sink in the solid-state supply and the cooling required by the 4X150A used in the amplifier. The high-voltage supply provides 1000 volts from a dc to dc converter and the bias supply is self adjusting.

The "Comtron" may be driven to 180 watts PEP by an exciter in the 5 to 30 watt range. It is compatible in appearance to the Gonset fixed-station linears, but is styled to the requirements of mobile operation. \$299.00 amateur net. For further details, write to Don Ward, Sales Manager, Gonset, Inc., 1515 S. Manchester Avenue, Anaheim, California 92803.

Skylane Quad Antennas

Skylane Products, manufacturers of multiple element quads, is introducing quad kits at greatly reduced prices. Two, three and four element quads may now be purchased in kit form, with either bamboo or fiberglass spreaders. These new kits are economically priced, yet easy to assemble. For more information, write to Skylane Products, 406 Bon Air Drive, Temple Terrance, Florida 33617.

High-Frequency RF Amplifier

A significant improvement in the design and performance of broadband, high dynamic range rf amplifiers has been announced by Comdel. The power gain of their new unit is 9 dB from 0.5 to 50 MHz and when installed in a 50 ohm system, the noise figure is less than 3 dB. The typical dynamic range of more than 140 dB insures freedom from cross modulation and makes gain control unnecessary. Typical applications for these new amplifiers include low power linear amplifiers (0.2 watts peak amplifiers, output), antenna broadband multicouplers, and broadband instrument amplifiers. Input power requirements are 18 to 22 Vdc at 40 mA-a 110 Vac selfcontained power supply is available with the amplifiers. For more information on the HDR 10 series amplifiers, write to Comdel Inc., Beverly Airport, Beverly, Massachusetts 01915.



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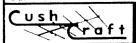
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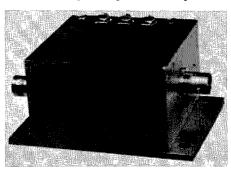
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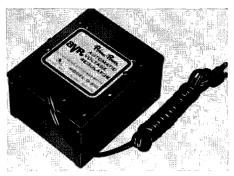
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High-Frequency RF Amplifier



A significant improvement in the design and performance of broadband, high dynamic range rf amplifiers has been announced by Comdel. The power gain of their new unit is 9 dB from 0.5 to 50 MHz and when installed in a 50 ohm system, the noise figure is less than 3 dB. The typical dynamic range of more than 140 dB insures freedom from cross modulation and makes gain control unnecessary. Typically applications for these new amplifiers include low power linear amplifiers (0.2 watts peak amplifiers, output), antenna broadband multicouplers, and broadband instrument amplifiers. Input power requirements are 18 to 22 Vdc at 40 mA-a 110 Vac selfcontained power supply is available with the amplifiers. For more information on the HDR 10 series amplifiers, write to Comdel Inc., Beverly Airport, Beverly, Massachusetts 01915.

Automatic Voltage Regulator

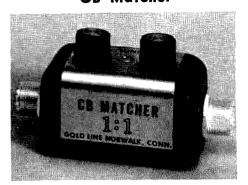


The Perma-Power company has just announced a line-voltage regulator for electronic equipment up to 400 watts. Although designed primarily for color television sets in areas where line voltage regulation is poor, there are many applications in the amateur station.

The regulator automatically boosts line voltage 10 volts when the line drops below

110 volts. When voltage is normal, the unit cuts out. It also shuts off when the equipment it is powering is shut off. Complete information is available from the Perma-Power Company, 5740 North Tripp Avenue, Chicago, Illinois 60646.

CB Matcher



Although designed primarily for CB operation, the new Gold Line CB Matcher should be useful for low-power operation on the ten-meter band. The CB matcher is an antenna matching network which can provide an SWR of 1.1:1 on the transmission line at all times. It is inserted between the transmitter and antenna and can be calibrated with an SWR bridge. For further information, write to Gold Line Connector, Inc., Muller Avenue, Norwalk, Conn. 06852.

IC Audio Power Amplifier

A high performance integrated circuit audio power amplifier is now available from Motorola. The MC1554G offers an audio output of one watt with total harmonic distortion of less than 0.4% from 20 to 20,000 Hz. The 1-watt output may be delivered to either direct coupled or capacitively coupled loads.

The input impedance of the MC1554G is 10k ohms and the output impedance is a low 0.2 ohms. This low output impedance is optimized for driving a 16-ohm loadcommonly encountered in audio and servo applications. The voltage gain of the unit is adjustable by means of external connections to three gain-adjust pins. Through these external connections, nominal voltage gains of 9, 18 or 36 may be selected. For zero signal input, the current drain is only 11 mA with a 16 V power supply. Price is \$15.00 each in quantities of 100. For more information, write to Technical Information Center, Motorola Semiconductor Products, Inc., Box 955, Phoenix, Arizona 85001.



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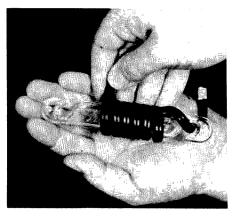


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The General Electric Company now produces a handy and inexpensive item, available at most hardware and department stores, which provides a neat method of shortening those excess ac power cords dangling from your equipment. The excess cord is simply wound around the plastic cord shortener and secured at each end in slots. Priced at 7 to 10 cents, the GE "Coilzit" goes a long way toward improving the appearance of the shack. Ask for GE catalog number GE-2550-0.

Kent A. Mitchell, W3WTO

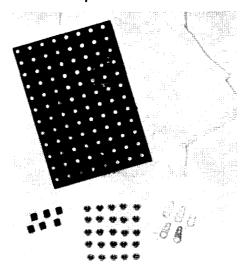
Semitron Zener Diodes

The Semitronics Corporation has just announced a new series of low-cost, heavy-duty zener diodes. These zeners are noted for their maximum surge capacity and stability. Rated at one watt, these Semitron zeners are encapsulated in an alkyd resin case and feature an inner epoxy seal, long leakage paths and low dynamic impedance. Zener voltages available are from 2.4 to 16.0 volts, ±10%, Price is 99¢, with lower prices for quantity purchases. For a copy of the SZ Zener Diode Data Sheet, write to Semitronics Corporation, 265 Canal Street, New York, New York 10013.

Remote Isolation Relay

Alco Electronic Products has just announced a new relay which should be very useful in many remote control and similar applications. This unit combines an isolated step-down transformer and a sensitive low-voltage relay into a single, trouble-free design. Although 110 Vac is required, the relay is activated by shorting the safe, isolated low-voltage circuit which can be run through ordinary surface wiring. Operates from 95 to 125 Vac with low current drain. Two basic models are available: the model FR-101, SPST, \$3.85 and the model FR-102, SPDT, \$3.95. For more information, write to Alco Electronic Products, Inc., Lawrence, Massachusetts.

Semitron Experimental Chassis Kit



For the home experimenter who does a lot of breadboarding, the new Semitron Experimenters' Perf-Board Kit looks ideal. It consists of a sturdy 1/8" tempered board with holes on 1/2" centers to prevent component crowding. Solid brass eyelets are supplied for easy soldering and insertion of a number of components leads through a single eyelet. If solderless connections and maximum construction speed is desired, the spring connectors supplied with the kit can be used for making rapid and mechanically secure connections.

The extremely low price of 89¢ for the kit makes it available to all—even beginners. For further information, contact Larry Rivman, Sales Manager, Semitronics Corporation, 265 Canal Street, New York, New York 10013.

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Letters

INTOLERANCE

Dear 73:

- Would it be wrong to say that some of the complaints in amateur radio represent intolerance—a mild form of the same disease in religion, race and politics? This shows up in discussions of GMT, Hertz, license classes, operating modes, activities . .

What amateur has earned the authority to tell all others they must use GMT in log-keeping if they want to be good operators? DX'ers are able to think in terms of DX, but casual operators cannot and need not. But, it is incumbent on the casual man to transpose to GMT in any and all DX QSL matters.

pose to GMT in any and all DX QSL matters.

Those in favor of Hertz and those in favor of cycles/second are antagonists. But really, practically, if one talks in Hertz and the other in cycles, they will understand each other.

How about the AM-SSB feud? Mechanically, these modes are somewhat antagonist. But the AM'er is intolerant when he puts carrier deliberately on a SSB QSO. And, the SSB'er is intolerant when he refers disparagingly to Ancient Modulation.

Dick Ellers K8JLK Warren, Ohio

SSB vs AM

Dear 73:

I didn't think much of your editorial this month—kind of stinks! I believe it is a ham's privilege to choose which mode of operation he desires, whether it is CW, SSB or Advanced Modulation. When are you SSB'ers going to give up trying to cram that "squawkin stuff" down everyone else's throats—don't you think it is their own decision?

J. C. Evans WØGSW Pittsburg, Kansas

Dear 73:

Agree with you on SSB only for the phone bands. AM is dead. Let's bury it.

D. G. Thibault WØNLH Chesterfield, Missouri

Dear 73:

Isn't it time u wr eliminated? DSB would defeat ur narrow bandwidth. I prefer AM for audio quality. SSB has no base power. It sounds rotten and I've listened on a lot of new revrs too. Splatter is terrible. SSB commercial fad—I don't want a xevr.. Even if you can make 1 kc precision gear—but u will never hve perfect operators!! It isn't the gear so much as these sloppy unrespectful operators on the air, particularly SSBers. What about static on SSB—ha ha. Wipes out SSB. SSB—Scientific Step Backward.

John Fickeisen WB2IQE Moravia, New York

Punctuation ours-grammar his!

Dear 73:

Fine business on your June editorial . . .

Ralph Campbell W4KAE Lexington, Kentucky

Dear 73:

Sideband is on the way out just a matter of a few more years like the FM fad in the 1950's.

R. Homrighausen WØUBI Paloa, Kansas

Ferrite Beads

Dear 73:

In connection with the Ferrite Bead article (73, April, 1967), I seem to have made an oversight.

Although the photo shows the bead on a dime, it is not necessary that a dime be incoroprated into the circuit. In the event that a dime is used as a pallet for the bead, it is not necessary that the dime he grounded

The bead people say that they used the dime to show the relative size of the component, but I suspect that they did this to confound any oriental imitators.

> Joe Williams W6SFM North Hollywood, Calif.

Happiness

Dear 73:

Happiness is receiving the June issue of 73 Magazine on May 31. Your new circulation manager is OK!

> R. F. Herbig W6MCS Arroyo Grande, Calif.

Dear 73:

. . . You really surpass QST and CQ. Keep up those great articles.

Bob WN3FNT

Phone Patching

The article on phone patches by K8BLL was very good and covered the aspects of patching well. There

is one point, however, he has overlooked.

As an ex-Ohio-Bell man, I have delved into company tariff regulations. There is a tariff for all telephone companies allowing for customer owned and maintained equipment. This allows large concerns to attach their own radio equipment to telephone company lines. The tariff requires that the equipment be maintained, and to be removed in case of difficulty with the lines until the trouble is located. There is no rate for this tariff. The tariff books are available at the telephone company office and can be examined upon demand.

If large companies can attach their radio equipment to telephone company lines, there should be no reason an amateur can not. Also, to keep cross-talk down, do not let voice peaks from the receiver hit the telephone line at more than +3 dBm.

> Jan Underdown K8LUR Napoleon, Ohio

Youth in Ham Radio

Dear 73:

I have just finished reading your editorial in the May 73 Magazine and would like to inform you that some of us are doing something to interest youth in amateur radio. Perhaps I can pass along a suggestion which may well help other groups in getting an organization started for this purpose.

The exploring program of the Boy Scouts of America offers a perfect opportunity for any amateur radio club or organized group of interested persons to sponsor a program for boys specializing in any of the hobby interests.

The Toledo Mobile Radio Association Incorporated has just finished organizing an Explorer Post for boys of high school age in the Toledo area. The specialty of this post is, of course, amateur radio. Starting with eight boys two months ago, the number attending meetings is already up to fifteen and expected by the end of the first year are between thirty and fifty boys in the program. The sponsoring organization provides its name, leadership, and a meeting place. TMRA has provided twelve adults for the Explorer Post Com-

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mittee and made arrangements for using Start High School in Toledo as a meeting place for the boys, Classes in code and theory are provided by the post leaders, while lectures and demonstrations by specialists within the club are put on a volunteer basis. Club members are also opening up their junk boxes and unused rigs for the boys as they become licensed. Plans are under way to have the entire post participate with the club on field day.

Any amateur radio club or organization interested in public service needs only to contact their local Boy Scout Service Center to get full information on the organization and operation of such a unit.

Bill Smith K8LFI Explorer Post 73 Toledo, Ohio

Break-in

The influx of "Break - Break," "10-4," "Charlie -Charlie," "Roger," "Over," "Go-ahead" boys is maddening. Nothing is more obnoxious to me than to 'Break - Break" when I'm right in the middle of a good conversation.

Most of these "Break - Break" boys, so I'm told come from the military, but I bet some are converted CB'ers, and still others fresh from fillibustering ancient modulators. Regardless of origin-is not good English the better way? Why not join in a QSO, rather than "Break" it. Say "This is W5XXX — may I join you?" or maybe even, "Hello Bill," if you know someone in the QSO.

Another thing, why fillibuster on SSB? Use VOX for realistic type conversations. You sound better and get more out of it. Push-to-talk is quick enough too. If a question is asked, you can answer it immediately. If the signal fades momentarily, you can repeat. What could be more natural?

Just listening to an old AM type fillibuster is boring. They sound like they are settling down for the night sometimes. There are long periods of silence (key still down), heavy breathing or chewing, and many yawns and repeats of what was said ten minutes ago. As far as I'm concerned, there was only one advantage to fillibustering; it gave the guy on the other end a chance to read the newspaper.

Well of course, all of this is my opinion. Is it fact? You be the judge. Amateurs are an independent lot. and everyone has his own ideas of what's best for him and the fraternity. And of course, he can do what he pleases-within bounds. But, I'm asking for help. Let's campaign for better English. Let's have names-not handles.

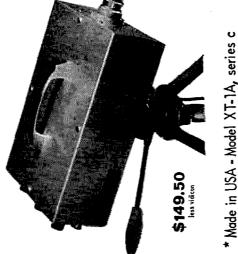
> John Gee K5AMF Dallas, Texas 75228

Help Needed

Our Red Shield Youth Center is in the process of organizing a radio club, and we have already secured our ham radio license. We are now in the process of securing the proper equipment, but we are still in need of one or two men who would be qualified to head up this club. I thought that perhaps your organization would be able to put me in touch with someone who might be interested in being the leader of our club. We serve children from ages six to eighteen who come from a financially deprived neighborhood, and so volunteer help is necessary for us to carry out many of our activities; therefore, we need a man or two who would be willing to donate a few hours once a week or so as a leader of our amateur radio club.

> G. P. Alexander, Director The Salvation Army Red Shield Youth Center 711 N. E. Dekum Street Portland, Oregon

Are there any Portland hams who can aid in this worthy cause?



Broadway

13th

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Technical Aid Group

The members of 73's Technical Aid Group are listed below. They are willing to help other hams with their technical problems. If you have a question about ham radio which can be answered adequately through the mail, write to one of the Volunteer TAG members whose specialty encompasses your query. Please write legibly and include a self-addressed stamped envelope with your request.

If you feel you are qualified to help other hams and would like to join the Technical Aid Group, write for complete details. To do the most good and to provide the best coverage, we need TAG members in all parts of the country. Right now all US call areas except W1 are represented as well as Europe

and South America.

Although 73 will help the Technical Aid Group with organizational help and publicity, we want it to be a ham-to-ham group helping anyone who needs help, whether they are 73 readers or not.

Bob Groh WA2CKY, BSEE, 123 Anthony Street, Rochester, New York 14619. Specializes in VHF/UHF solid-state power amplifiers, but will be glad to make comments on any subject.

Jim Ashe W2DXH, R.D. 1, Freeville, New

York. Test equipment, general.

G. H. Krauss WA2GFP, BSEE, MSEE, 70-15 175 Street, Flushing, New York 11365. Will answer any questions, dc to microwave, state-of-the-art in all areas of communications circuit design, analysis and use. Offers help in TV, AM, SSB, novice transmitter and receivers, VHF antennas and converters, receivers, semiconductors, test equipment, digital techniques and product data.

Don Nelson WB2EGZ, EE, 9 Greenridge Road, Ashland, New Jersey 08034. VHF antennas and converters, semiconductors, selection and application of vacuum tubes.

Stix Borok WB2PFY, high school student, 209-25 18 Avenue, Bayside, New York 11360.

Novice help.

Richard Tashner WB2TCC, high school student, 163-34 21 Road, Whitestone, New York 11357. General.

J. J. Marold WB2TZK, OI Division, USS Mansfield DD728, FPO San Francisco, California 96601. General.

Clyde Washburn K2SZC, 1170 Genesee Street, Building 3, Rochester, New York 14611. TV, AM, SSB, receivers, VHF converters, semiconductors, test, general, product data.

Theodore Cohen W9VZL/3, BS, MS, PhD, 261 Congressional Lane, Apartment 407, Rockville, Maryland 20852. Amateur TV, both conventional and slow-scan.

James Venable K4YZE, MS, LLB, LLM, 119 Yancey Drive, Marietta, Georgia. AM, SSB, novice gear, VHF, semiconductors, and test equipment.

J. Bradley K6HPR/4, BSEE, 3011 Fairmont Street, Falls Church, Virginia 22042.

General.

Wayne Malone W8JRC/4, BSEE, 3120 Alice Street, West Melbourne, Florida 32901. General.

Bruce Creighton WA5JVL, 8704 Belfast Street, New Orleans, Louisiana 70118. Novice help and general questions.

Louis Frenzel W5TOM, BAS, 4822 Woodmont, Houston, Texas 77045. Electronic keyers, digital electronics, IC's, commercial equipment and modifications, novice problems, filters and selectivity, audio.

George Daughters WB6AIG, BS, MS, 1613 Notre Dame Drive, Mountain View, California. Semiconductors, VHF converters, test

equipment, general.

Tom O'Hara W6ORG, 10253 East Nadine, Temple City, California 91780. ATV, VHF converters, semiconductors, general questions.

Steve Diamond WB6UOV, college student, Post Office Box 1684, Oakland, California 94604. Repeaters and problems regarding legality of control methods. Also TV, novice transmitters and receivers, VHF antennas and converters, receivers, semiconductors, and product data.

Orris Grefsheim WA6UYD, 1427 West Park, Lodi, California 95240. TV, HF antennas, SSB, VHF antennas and converters, receivers, semiconductors, and general questions.

Hugh Wells W6WTU, BA, 1411 18th Street, Manhattan Beach, California 90266. AM, receivers, mobile, test equipment, surplus repeaters.

Howard Krawetz WA6WUI, BS, 654 Barnsley Way, Sunnyvale, California 94087.

HF antennas, AM, general.

Howard Pyle W7OE, 3434-74th Avenue, S.E., Mercer Island, Woshington 98040. Novice help.



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WANTED: Copies of VHFER magazine, years 1963 and 1964 for personal collection. W1DTY, RFD 1, Box 138, Rindge, N.H. 03461.

WANTED: Sonar and magnetometer equipment; also technical manuals and books on the subjects. Please forward offers to Box 1492, care of 73 Magazine, Peterborough, N. H.

COLLEGE COSTS: SBE-34 Xcvr, original carton with mike and cables, \$275. Matching SB-2LA linear, \$150. Both for \$400. Bob Buckman, K9AIY, 1221 N. Milwaukee St., Milwaukee, Wis., 53202. Phone 414-273-5096.

SIX ASSORTED ISSUES of ATV Experimenter, circa. '64-'65, \$1 from 73 Magazine, Peterborough, N.H. 03458.

HQ-170-A, \$195. Johnson Pacemaker SSB, \$1**6**0. HA6 and HA2 transverters with power supply, \$195. All good condition. Chuck Keeton, K8OBW, 4126 Cloverhill Dr., Canton, Ohio 44706

DRAKE 2B with 2BQ, calibrator, manuals, excellent condition, \$200. Eico 753 with 751 AC supply, solid state VFO, desk microphone, manuals, new condition, \$225. Will ship prepaid in USA. William L. Wallace, K8HYY, Route 6, Box 110, Xenia, Ohio, 45385.

WANT to borrow manual for Hallicrafter S-27 receiver so I can make photocopy. Will purchase manual if you want to sell. WIDTY, RFD 1, Box 138, Rindge, N.H. 03461.

RTTY GEAR FOR SALE. List issued monthly. 88 or 44 MHy toroids, five for \$1.75 postpaid. Elliott Buchanan and Associates, Inc., 1067 Mandana Blvd. Oakland, California 94610

6288 FEET HIGH for 6 & 2 DX on Mt. Washington, N.H. Take your gear up on the Cog RR from Base Station. Food and facilities available at Summit House, also bunks for overnight.

WANTED: Tubes, transistors, lab instruments, test equipment, panel meters, military and commercial communication equipment and parts. Bernard Goldstein, Box 257 Canal Sta., New York NY 10013

DUMMY LOAD 50 ohms, flat 80 thru 2 meters, coax connector, power to 1 KW. Kit \$7.95, wired \$11.95. PP, HAM KITS, Box 175, Cranford, N. J.

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WANTED: All types of aircraft, ground radios and tubes, 4CX1000As, 4CX5000s, 304TLs, etc. 17L7, 51X, 618S, 618T, R388, R390A, GRC units. All 51 series. All Collins ham or commercial items. Any tube or test equipment regardless. For fast, fair action. Ted Dames Co., W2KUW, 308 Hickory St., Arlington, N. J. 07032

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INTERNATIONAL TEEN-AGE NET (ITAN) is looking for new members. If you are a teenager we want you. Inquiries should go to Net Control station ITAN, WA7FDF, 17728 22nd St. N. E., Seattle, Washington 98155

RTTY FOR SALE Mdl-14, 15, 19 sync motors with fan \$10.00; 255 polar relays \$2.50; Three-headed T.D.s, \$60.00. B. L. Ferris, P.O. Box 672, East Flat Rock, N. C. 28726

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COLLINS SM-2 desk top microphone complete. one month old absolutely perfect condition. Original cost \$48.00. First check for \$25.00 takes it. Dick Burne, K3KAW, 514 Waverly Ave. Clarks Summit, Penna. 18411.

want to correspond with Hams and SWLs in USA and other parts of the world. Would also like to receive club magazines from radio clubs. K. Harvant Singh, 31, (774), Upper Museum Rd., Taiping, Perak, West Malaysia, Malaysia.

NECKTIES, red, blue or green, with your call emblem or design, hand painted. Wear to conventions, hamfests and club meetings. \$3.00 postpaid. A&B Specialties, 1519 SE Hamilton St., Roseburg, Oregon.

CE-100V serial 790. Mint condition, little used. Original carton, manual and pair of spare 6550's. \$400.00, W3NKS, 312 West Timonium Road, Timonium, MD 21093.

TEKTRONIX 511AD scope, 10 MHz bandwidth, good shape with instruction book. \$150. Paul Franson, WAICCH, 38 Heritage Rd., Acton, Mass.

SOUTH HILLS BRASS POUNDERS & MODULA-TORS 27th annual hamfest will be held August 6th at St. Clair Beach, 5 miles south of Pittsburgh, Penna., on route 19. For further inforation write W3WFR, 1500 Tretter Drive, Pittsburgh. Pa.

QUAD CITY AMATEUR RADIO CLUB, of Moline, Illinois, and the Davenport Amateur Radio Club, of Davenport, Iowa, will hold a hamfest Sunday, August 20th, at Fairy Land Park, route 61, 12 miles north of Davenport, beginning at 8 A.M. Trunk sales, prizes, hidden xmtr hunt (6 meter and CB). Advance ticket donations: \$1.40 or 3/\$4. Contact Wayne Youngberg, WA9RDG, 2308 Stadium Dr., Rock Island, Illinois.

WANTED: Instruction manual for the Hallicrafters S-27 UHF receiver or copy. I will make copies if there is a manual available for loan. W1DTY, RFD 1, Box 138, Rindge, N.H. 03461.

SOUTHWESTERN/PACIFIC DIVISIONS ARRL CONVENTION September 8-10, Ambassador Hotel, Los Angeles. Registration \$2 (with banquet \$10) until Aug. 15; thereafter \$3 and \$12. Checks to "ARRL Convention", and send to Box 3151, Van Nuys, Calif. 91405.

SIX METER CLUB OF CHICAGO, Tenth annual picnic and mobile meet, Sunday, August 6th, at Picnic Grove, on Route 45 one mile north of Route 30, Frankfort, Illinois. For further information write Alfred Bagdon, K9YJQ, Chairman, 7804 W. 66th Place, Bedford Park (Argo P.O.), Illinois 60501.

INTERNATIONAL CHC/FHC CONVENTION: Third annual convention, at Stouffer's Inn, 120 W. Broadway, Louisville, Ky., August 3, 4 and 5, 1967. For further information write Fred Gleeson, WA4LMD, Box 20114, Louisville, Ky. 40220.

ALBERTA CENTENNIAL Amateur Radio Convention. Calgary, Alberta, Canada, July 8-9, 1967. Write to VE6NQ, Box 592, Calgary, Alberta, for full information.

ST. LOUIS COUNTY, MISSOURI: Second annual hamfest of the Suburban Radio Club, Sunday, July 30th, 1967, at Creve Coeur Lake Memorial Park, St. Louis County. For further information write Joe Owings, KØAHD, Suburban Radio Club, 10217 St. Daniel Lane, St. Ann, Mo. 63074.

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NOVICE AND TECHNICIAN HANDBOOK by W6SAI and W6TNS. Limited quantity for only \$2.50 each. 73 Magazine, Peterborough, N.H. 03458.

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MONCTON AREA AMATEUR RADIO CLUB, is sponsoring Atlantic Centennial Amateur Radio Convention, at the Brunswick Hotel, Moncton, New Brunswick, September 2-4. Contact Mrs. Audrey Hughes, Chairman of the Registration Committee, at P. O. Box 115, Moncton, New Brunswick, Canada. U.S. Hams planning to attend this should waste no time writing the Department of Transport Office (Canada to Canada to partment of Transport, Ottawa, Canada, to arrange a permit to operate when there.

LANIERLAND AMATEUR RADIO CLUB of Gainesville, Georgia, will hold its annual Hamnic on August 6th, to help support its great work of providing radio equipment for disabled amateurs in the North Georgia area. Contact the club at P. O. Box 150, Gainesville, Georgia, 30501, for information as to location and time of this

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W9 DX CENTURY CLUB will hold this year's meeting on September 16 at Holiday Inn of Chicago-O'Hare, Schiller Park, Illinois. G2MI, RSGB QSL Bureau, will be guest DX personality.

INTERNATIONAL FIELD DAY 9 A.M., August 13th, at Cliffside Country Club, Burlington, Vermont, sponsored by Burlington Amateur Radio Club, Inc. Busy day for OM, XYL and JRs. Contests, Bingo, Chicken barbecue at noon, Special Trio for the teenagers. Swap-shop and auction, Net meetings, Swimming, Boating, Eye-ball QSO's. Talk-in freqs. 3909 SSB, 3855 AM, 146.94 FM-146.34 FM (Rep.). Door prizes, Raffles, \$3.00 at the gate, \$2.50. Early Bird registration. Send early registrations to WIOKH, Lloyd Tucker, Box 16, Essex Center, Vt.

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SELECTRONIX AUDIO FILTER, use between receiver and speaker or phones, cuts monkey chatter and narrows band pass to about 1000 Hz. Some QSO's possible only with this in circuit. \$24.95 pp. WØRA/1, Box 115, Greenfield, N.H. 03047.

THE LONG ISLAND HAMFEST will be held at Hempstead Town Park, Point Lookout, Long Island, N.Y., on Sunday, July 16th beginning at 9:00 A.M. Bring your family and enjoy the fun. For further information write Federation of L. I. Radio Clubs, Box 304, Long Beach, N.Y.

CAPE KENNEDY HAMFEST, sponsored by Platinum Coast Amateur Radio Society. Second annual hamfest, at the civic auditorium, Melbourne, Florida, August 26 and 27. Home-making and flower shows. Swap tables and equipment auction the hit of the 1966 hamfest. Give-away every hour, and of course BIG, BIG door prizes. Fun for the XYL, the kiddies and the OM himself. For information write Box 1004, Melbourne, Florida.

DELAWARE HAMFEST will be held August 27 at Banning Park, Wilmington, Delaware. Rain date: September 3. For more information, contact Bill Robinson, 204 W. Delaware Ave., Wilmington 19809.

DONATE YOUR EYES SO THAT ANOTHER MAY SEE

Great advances have been made over the past 25 years in the repair of damaged corneas, the clear substance that covers the pupils of your eyes. The only material that can be used to make these repairs comes from other eyes—those WILLED by their owners for removal within 4 hours after death, and the degree of success in these operations is astonishingly high.

Hundreds of people every year are able to see again because of these donations, but even so the availability of eye material is so limited that the majority of the over 75,000 who should have this surgery will not live long enough.

The need now is for hundreds of thousands of additional pledges to produce an ever increasing availability. A thousand pledges today may produce no material for many years, so the greater the pledge group, especially among the upper age levels, the greater the chance that many of those who need this transplantation will indeed live to see again.

Obtaining these pledges has been a project of Lions Clubs in many cities, and their members, or Doctors and Hospital Administrators, can direct you to a source of pledge cards which you and your family must complete to make an eye donation valid. Here is a project for entire families. What greater gift could you give to a fellow man!

Amateur Radio's participation in this work can be heard every day of the year on 3970 kHz, currently at 7 A.M. and 8 P.M. EST, as the Eyebank Network locates the availability of and/or the need for corneal transplant material among the nations 57 Eye-Banks.

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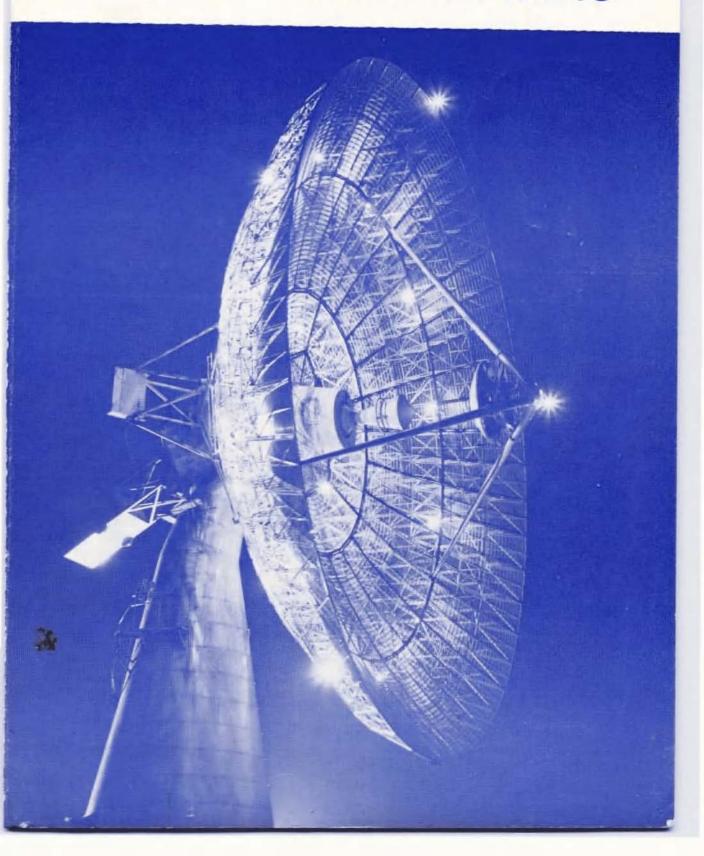
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SEPTEMBER 1967

AMATEUR RADIO



73 Magazine

September 1967

Vol. XLVI No 9

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My comments on the use (and elimination) of amplitude modulation on the bands below 30 MHz in the June issue were not taken lightly. The AM operators have denounced me, indicted me, called me narrow minded and expressed desires to have me tarred and feathered. For a review of some of these choice epistles, turn to the letters section in the back of this issue.

None the less, *most* of the arguments in favor of AM are as outmoded as amplitude modulation itself. Granted, good AM sounds better than good sideband. However, we are supposed to be communicators, not broadcasters. If you doubt this, take a close look at the regulations—broadcasting on the amateur bands is specifically forbidden.

The chaps who say that sideband is just a passing fancy echo the cry of the spark operators who held out to the last minute in the 1920's. The fellows who argue that AM is more efficient are badly misinformed. In fact, for the same received signal-to-noise ratio, the AM station must run 2.88 times as much power as the SSB station.

Interestingly enough, for input signal-to-

noise ratios greater than about 7 dB, FM systems (with a deviation ratio of 2) are almost 11 dB better than AM and 8 dB better than sideband. However, below this point the results with FM drop off rapidly and, at low input signal-to-noise ratios, FM is inferior to both AM and sideband. Single sideband maintains a constant 3 dB advantage over AM, regardless of the signal level.

While most AM stations use simple diode detectors in their receivers, a few have gone to coherent detection. This approach appears to give AM a 3-dB advantage, but this advantage is lost due to a 3-dB noise increase because the predetection bandwidth is twice as wide.

With strong-signal and low-noise conditions, almost any mode of radio communications will provide the desired results, but you don't evaluate under the best conditions, you use the worst. Under the worst conditions, single sideband will usually provide the only usable telephonic communications, and AM and FM will be completely covered up by static, interference and noise.

Some of the AM operators are under the impression that since I am advocating the complete elimination of AM on our bands below ten meters, I am in favor of appliance operators. Nothing could be further from the truth. There is no reason why most hams should not be able to build a complete single sideband system. I don't know where the mistaken notion came from that you have to be some kind of electronic genius or engineer to build a SSB rig. It's not so. It just reflects the technical competence of today's amateur radio society.

Some AM'ers complain about the high cost of sideband. This is true if you are an appliance operator, but if you build your own SSB exciter, and have a decent junk box, the cost is comparable. The only special components you have to have are a filter or a phase-shift network. Audio phase-shift networks cost less than ten dollars, and high quality crystal and mechanical filters are often available on the surplus market within the same price range. You can't buy much of a modulation transformer for ten bucks!

There have also been a lot of complaints

(Turn to page 111)

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W2NSD in India

My original plan had been to fly from Afghanistan to Pakistan for a couple days and then on to New Delhi in India. Alitalia had confirmed my airline reservations, but when I got to Kabul I found that there aren't any flights from Pakistan to India. The two countries are essentially at war. So I stayed on an extra day in Kabul and then flew directly to New Delhi and spent the extra time there.

Apparently the Chinese have heavily infiltrated Pakistan and have a lot of influence there. If you consult a map of the world for a moment, you will see why Pakistan is so important to China. The western part of China is bottled up by Russia and, if they are going to open up that part of the country at all, it really has to be either through India or Pakistan. They tried the India route and the U.S. started talking about sending in troops to help out. So they have been concentrating on Pakistan and have apparently been winning there without sending troops. Naturally they are anxious to keep Americans out of the country as well as most other tourists. I think this also explains why we haven't heard many AP stations active for so long.

India, from the air, looked green and beautiful. I was surprised. I had sort of expected to see a dry and dusty country where agriculture was a fight against drought. It was in the 90's when I landed at New Delhi and the sun was beating down. The customs officials were cool. I had to do more paperwork here than in any other country I had visited. They wanted a complete list of my cameras, serial numbers, everything. They wanted a list of all money that I was bringing into the country. I filled out forms and more forms. My five cameras caused a great deal of difficulty . . . only two cameras permitted . . . but I finally made it through. I was inexperienced and didn't know that all this bother was just a signal to slip a little money into the palm to smooth my way through. Bribery, I found out later, is a basic way of life here.

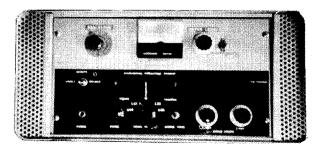
(Turn to page 98)

The Synchronous Detection Process

If you want to get the most out of AM or DSB communications, try the synchronous detector. With a synchronous detector at both ends of an AM communications link, the system is as effective as single sideband.

Synchronous detection, when adapted to a communications receiver with an *if* bandpass of six kHz or better, provides an excellent means of single signal reception, along with the capabilities of almost complete rejection of non-synchronous components such as single sideband, RTTY, unmodulated carriers, static, and most spurious sideband splatter emanating from off-frequency signals. It provides a means of phase locking the detector on synchronous type transmissions such as DSB with carrier, DSB without carrier, NBFM, and phase modulation.

A block diagram, shown in **Fig. 1**, gives the basic elements of the system used at W3DUQ. Blocks marked with an X are the ones necessary for basic synchronous detection if the stereo synthesizer, as will be described later, is not desired. The basic sys-



The synchronous detector.

tem utilizes eleven dual purpose tubes.

Following the block diagram, the signal input is applied to each 7360 demodulator (V1, V2), and the local 455 kHz oscillator voltages are applied to each demodulator in phase quadrature (90° apart), Assume, momentariy, that the "I" channel local oscillator injection voltage is the same phase as the carrier (transmitted or suppressed) component of the AM signal. Then the in-phase or "I" channel will contain the demodulated signal, while the "Q" channel will contain no audio, as its injected local oscillator voltage is shifted 90°. Now, if the local oscillator or signal drifts slightly, the "I" channel will be unaffected, but the "Q" channel will produce some audio. This will have the same polarity as the "I" channel audio for one direction of local oscillator or signal drift, and opposite polarity for the opposite direction of local oscillator or signal drift. The "Q" channel level will be proportional to the oscillator drift, for shifts of 300 Hz or less. By simply combining the "I" and "Q" audio in an audio phase discriminator (V4 and associated circuitry), a dc control signal is obtained. This control voltage tunes the oscillator (V5B) via the reactance tube (V5A), and returns or locks the oscillator to the correct phase where audio is present only in the

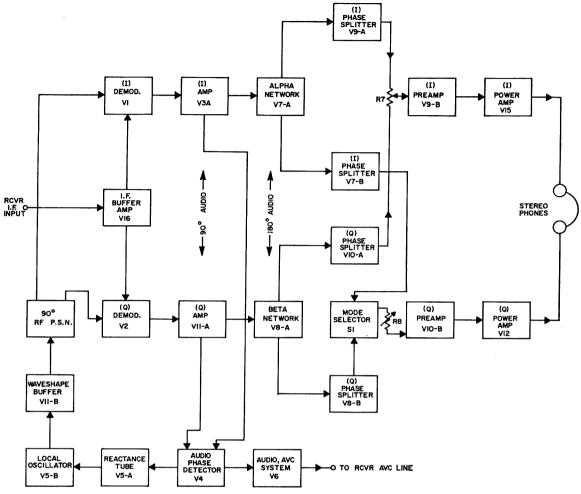


Fig. 1 Block diagram of the synchronous detector

"I" channel.

The audio phase detector delivers a do voltage only when the "I" and "Q" signals have in-phase (synchronous) components. Since the "I" and "Q" audio will be in phase quadrature in any case, where the like sidebands do not exist on each side of the carrier, the phase detector provides no AFC voltage for SSB, static, or CW signals, and is therefore totally unaffected by this type of interference.

If the "I" and "Q" audio outputs are taken through alpha and beta networks respectively (90° audio phase-shift networks), interference rejection on the order of 60 dB may also be obtained. When locked on a signal containing interference on the lower sideband, for example, the "I" channel produces audio resulting from both locked signal sidebands plus lower sideband interference, while the "Q" channel contains only the interfering audio on the lower sideband. Phase cancellation, by combining the two

audio outputs from the alpha and beta networks, will remove the interference while still adding the desired information contained in both sidebands. By simply reversing the take-off points from the alpha and beta network outputs, similar rejection is obtained for interference contained in the upper sideband.

With the addition of the stereo synthesizer circuits, one output channel will contain the synchronous signal plus interference contained in the lower sideband, while the other channel contains the synchronous signal plus interference contained in the upper sideband. By phase cancellation, the brain (being the ultimate computer), picks out the synchronous signal while rejecting the undesired interference contained in both of the sidebands, and all you hear, basically, is the synchronous signal you want to hear!

Similarly, by unlocking the dc correction signal, SSB signals may be received in much the same manner of the good old standby—

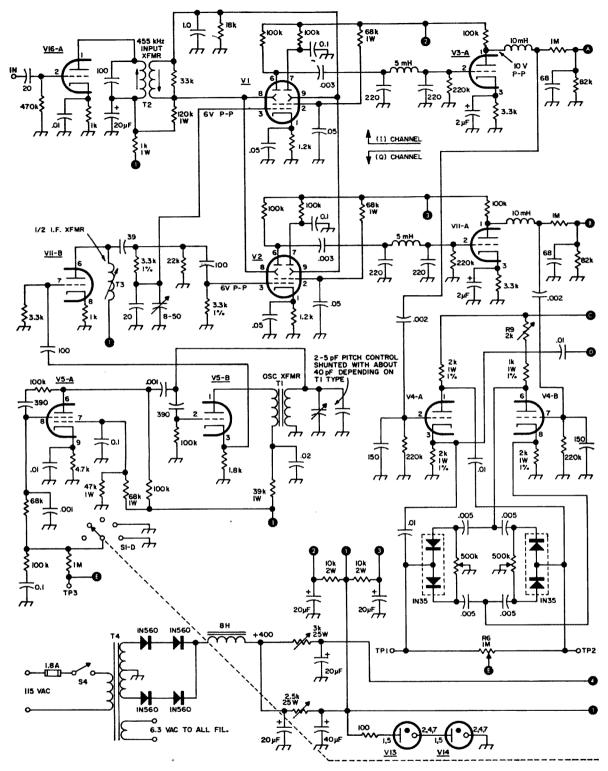


Fig. 2 Schematic diagram of the synchronous detector. TI is a capacitor tuned 455 kHz if transformer with one winding removed and 150 turns of #36 enamelled wire wound over the primary. Transformers T5 and T6 are 5-watt output units, 5k primary, 8-ohm secondary.

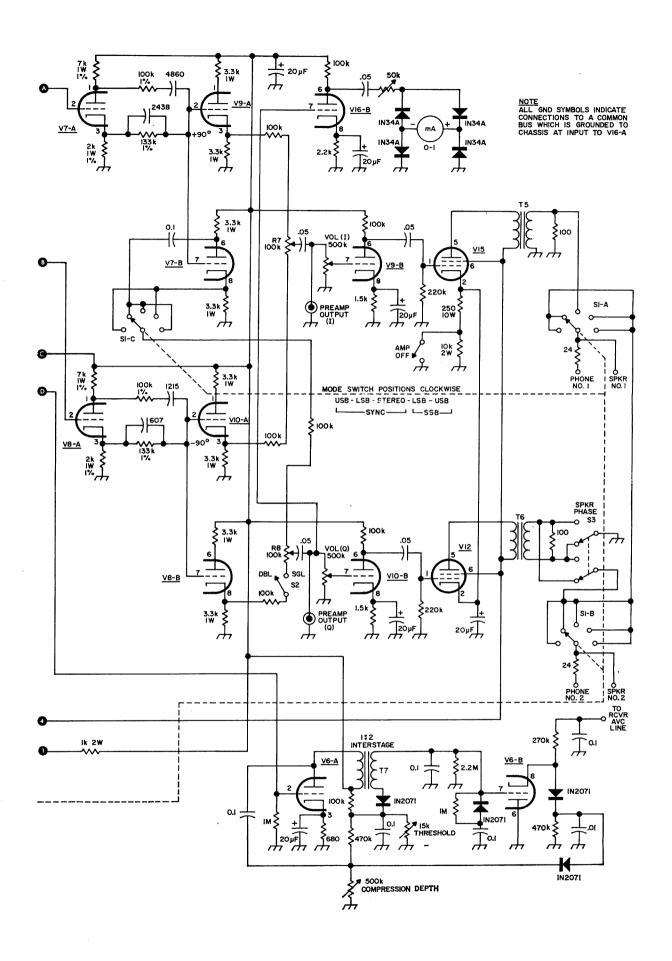
the sideband slicer, with over 60 dB of rejection on the unwanted sideband!!

Construction notes

Care must be taken to ensure that the 7360

demodulators are placed in a minimum ac field, or hum in the system will result, due to the high sensitivity of these beam deflection tubes.

Standard wiring procedure should be followed, with leads as short as possible, and



DC Voltages—Synchronous Detector Without if Signal

Tube No.	Type	1	2	3	4	5	6	7	8	9
VI	7360	5	150		Fil	Fil	80-100	80-100	25	25
V2	7360	5	150		Fil	Fil	80-100	80-100	25	25
V3	12AU7A	75		3.5	Fil	Fil				Fil
V4	12AU7A	240		- 11	Fil	Fil	240		11	Fil
V5	6AN8	60	 I	4.7	Fil	Fil	200	100		3
٧6	12AU7A	247		8	Fil	Fil		0-50	0-12	Fil
V 7	I2AT7	240	5.5	8	Fil	Fil	212	6.5	10	Fil
V8	12AT7	240	5.5	8	Fil	Fil	212	6.5	10	Fil
V9	12AT7	212	6.5	10	Fil	Fil	120		1.7	Fil
V10	12AT7	212	6.5	10	Fil	Fil	120		1.7	Fil
VII	12AU7A	75		3.5	Fil	Fil	246		2.5	Fil
VI2	6AQ5A		15	Fil	Fil	246	250			
VI3	OB2	250	150		150	250		150		
V14	OA2	150				150				
V15	6AQ5A		15	Fil	Fil	246	250			
V16	12AX7	240		3.2						

Notes: Oscillator injection at VI, V2 is 6V p-p; maximum signal at V4 grids to be set at 8V p-p with RI; audio at V9b, VI0b grids 100 mV p-p; adjust R2 for —I volt dc on oscillator grid; set AVC depth control for 8-10 volts p-p at V4 grids with external BFO on and detuned I kHz.

the oscillator-reactance tube and associated circuitry should be kept away from the rest of the circuit as much as possible, to avoid 455 kHz pick-up by audio circuits.

Receiver modification and avc set-up

Take if out of the receiver (455 kHz) at the plate of the last if amplifier stage, through a 20 pF capacitor to RG62/U coaxial cable, to the grid of V16.

Modify the receiver avc switch to provide an external input position for the detector audio hang AVC voltage. Peak the *if* transformer in the plate of V16 with the rf gain wide open, the AVC switch in *external* receiver AVC, the receiver bfo or crystal calibrator on, and the detector oscillator detuned one kHz from the center of the *if* passband. Note the S-meter reading. Now switch the receiver to *internal* AVC, and note the S-meter reading. If the two meter readings are more than 5 dB apart, adjust the value of R1 (33k) until the meter readings agree.

Quadrature set-up

Tune the local oscillator to the center of the receiver *if* passband (you can use the receiver bfo for this), and set-up the oscillator injection quadrature, and alpha-beta networks as follows.

With the receiver tuned 1 kHz from an unmodulated carrier, set switch SI to the position giving the least audio output, and alternately adjust the 8-50 pF trimmer in the oscillator quadrature circuit, and R8 for minimum audio output at "Q" preamp output. Now adjust R7 for minimum audio output on its rejected sideband at "I" preamp

output.

If the 8-50 pF trimmer adjustment is not the same for the opposite sideband selection on SI (retune receiver to 1 kHz on the other side of zero beat for this test), the alpha and beta networks are off balance and can be brought in by judiciously trimming the 7k and 2k plate and cathode resistors on V7a and V8a, while adjusting the 8-50 pF trimmer and R8 until a minimum audio output results on either sideband.

Audio phase discriminator set-up

- 1. Short R3 to ground.
- 2. Tune the receiver 1 kHz from an unmodulated carried (crystal calibrator works fine here) and adjust the rf gain for four volts rms audio on the plates of V3a and V11a.
- 3. Connect a dc VTVM or dc oscilloscope to TP1 and adjust R4 for minimum dc.
- 4. Move the VTVM to TP2 and adjust R5 for minimum dc.
- 5. Move the VTVM to TP3 and adjust R9 for minimum ac.
- 6. Remove ground from R3 and adjust R6 for minimum ac at TP3.
- 7. Repeat steps 3 and 4 until step 6 yields no ac output.

Notes

- 1. The output at the preamp output jacks is approximately 200 millivolts peak to peak.
- 2. For stereo reception, adjust the two 500k volume controls and the speaker phasing switch (using stereo headphones), until minimum interference on a locked synchronous signal is observed.

- 3. Adjust the compression depth control (500k) along with R1 for best synchronous locking. Value should come out on the depth control to about 400k.
- **4.** SI positions, starting at full counter clockwise:
 - a. Reject upper sideband.
 - b. Reject lower sideband.
 - c. Stereo (reject lower "Q", reject upper "I" on earphones).
 - d. Receive lower sideband-AFC off.
 - e. Receive upper sideband-AFC off.
- 5. For best synchronous locking on double sideband signals, the receiver should be tuned 100 Hertz or closer to signal zero beat.
- 6. Set VR current (V13, V14) for 2.2 volts dc across the 100-ohm resistor at V13 pin 1 using the 2.5k, 25-watt adjustable resistor.
- 7. Set plate voltage for V12, V15 (6AQ5's) for 270 volts, using the 3k, 25-watt adjustable resistor.
- 8. If the stereo feature is not desired, eliminate V9, V10, V12, V15, and take the audio output from the center tap of R8.

Now sit back and enjoy QRM free reception.

In 1965, a test involving over two hundred students was conducted at Cambridge University, in England. Under controlled conditions, two transmitters were put on the air; one AM, the other SSB. The SSB transmitter was running twice the power output of the AM transmitter. Two identical receivers were set-up, one with a product detector for SSB reception, the other with a synchronous detector for AM reception. Each student was to copy a message, first from one receiver, then the other.

Then white noise was injected into both receivers, 3 dB at a time. In the end, the AM signal, running one-half the power output, was easily copied with over 6 dB more white noise injected into the receiver, while the SSB signal was completely washed out. So you see, it's not the mode of transmission so much as it is the method of detection.

Let's get rid of those outdated, wideband. distorted telephone quality single sideband gizmotchies; and put some good, narrow, maximum intelligibility advanced modulation back on so we may soon rid the bands of 30 kHz wide signals and once again enjoy good, solid communications.

. . . W3DUQ

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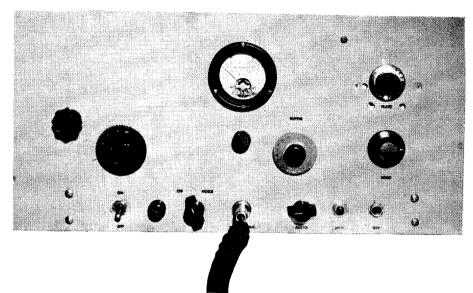
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Sam Kelly W6JTT 12811 Owen Street Garden Grove, California

A 160 Meter Sidewinder

A simple double-sideband and CW transmitter for 160 which uses readily available parts.

160 Meters is a band that is virtually ignored by equipment manufacturers. This makes it even more fun to build your own equipment. After operating CW and platemodulated AM on the band with a converted TCS, I decided to experiment with double side band suppressed carrier. The DSB has several advantages over AM. The carrier is eliminated giving you more "talk power", inter-channel heterodynes are reduced and the equipment is simple to build.

This low cost DSB/CW transmitter was built entirely from junk box parts. Most of the final tank components were salvaged from TU-5 tuning units which are available surplus for about \$2 each.

The transmitter was built on a 17 x 13 x 2 inch aluminum chassis. A standard 8¾ inch aluminum EIA panel was used. Parts layout isn't critical, but the rf leads should be kept

as short as possible. The 100 microamp meter was used because it happened to be in the junk box. A 0-1 mA meter would be less likely to be damaged and can be substituted by simply reducing resistors R_{\shortparallel} and R_{\shortparallel} by a factor of 10. Construction was done in stages starting with the power supply. Each stage was checked out before proceeding to the next stage.

Power supply

The power supply uses separate plate and filament transformers. The filament transformer has a 6.3 V and 12.6 V winding which were placed in series to provide 18.9 Vac for the relay supply. The plate transformer has low voltage taps which were used for the oscillator supply. A dropping resistor can be used to get this voltage if a tapped transformer isn't available.

Modulator

The modulator is straight forward until you get to the modulation transformer. It is a 400 Hz power transformer rated at 115 V primary and 750-750 on the secondary. I salvaged this one from an airborne jamming transmitter. Any 400 Hz power transformer having at least 5:1 turns ratio will do.

A two-stage 12AX7 speech amplifier was used to provide adequate gain for a crystal microphone. The leads to the gain control and to the grid of the 6V6 must be shielded to prevent the amplifier from oscillating. The 6V6 is run with 350 volts on the plate and screen, providing ample drive for the 5933 screens.

Oscillator

The VFO is a Hartley oscillator. The tuning capacitor was salvaged from a command transmitter (or they can be bought for \$1.50 each from Fair Radio Sales). Removing one third of the plates spreads the band over most of the dial. A 1-inch piece of ¼ inch diameter brass shafting was drilled out and sweated on the small tuning shaft to accommodate a more convenient size tuning knob. The capacitor was mounted on a ¼ inch thick stiffener plate to reduce the effect of chassis flexure on oscillator frequency. The oscillator coil is wound on a ceramic form mounted in a shielded compartment on the underside of the chassis. Take special care

to insure that the coil and shield are mechanically sturdy.

Buffer

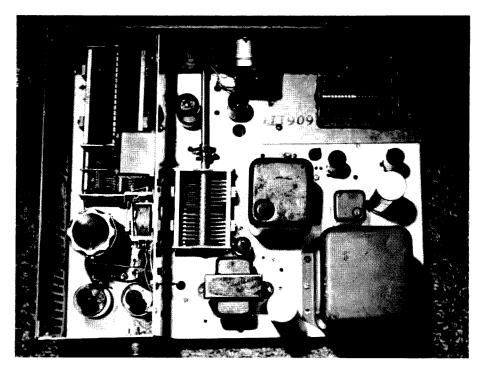
The 12BY7A buffer-amplifier is straight forward. Be sure that the internal shield and suppressor grid are grounded right at the socket by short leads. Use a good quality ceramic socket. The split stator tuning capacitor was made by sawing the stator section of the 135 pF tank capacitor (from a TU-5 tuning unit) in half. The small trimming capacitor is used to balance the input. Be sure to isolate the buffer tank from the final amplifier tank to prevent the final from taking off and oscillating!

Final amplifier

The final amplifier consists of a pair of 5933's with their grids in push-pull and their plates in parallel. The 5933 is just a short, ruggedized 807. 807's or 1625's could be used just as well. If you use 1625's you will need a 12V filament supply. A pi section output is used. All final tank components, including the antenna transfer relay, are located in a tightly shielded compartment. Coaxial connectors for the receiver and antenna are located at the back of this compartment.

CW operation

The final amplifier circuit is just our old friend the push-push miltiplier in disguise.



Top view of the transmitter. The homemade split-stator capacitor is in the center.

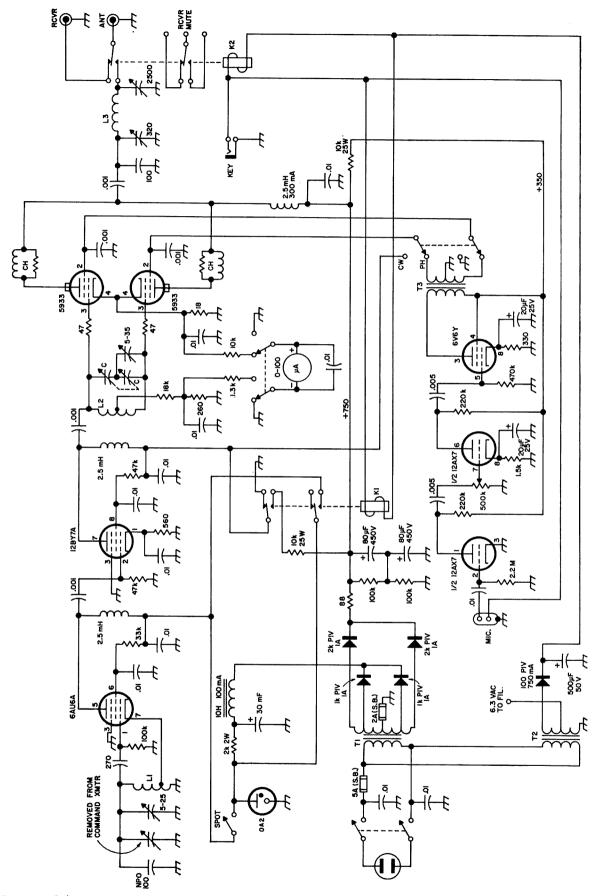
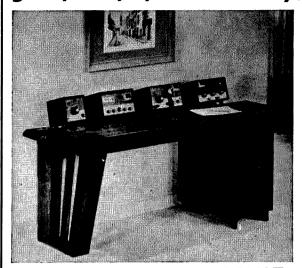


Fig. 1. Schematic diagram of the 160 meter CW/DSB transmitter.

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It doesn't work well with both tubes as a straight-through CW amplifier. For CW one tube is disabled by grounding its screen grid (this could also be done by turning off the filament). The oscillator and screen grid are keyed simultaneously. Be sure to wire K-1 as shown. This grounds the screen grid in the key-up position to prevent the final from oscillating. Power input on CW is 75 watts.

Check out

After smoke testing, place the CW-phone switch in the CW position. Connect the transmitter to a 50-ohm dummy load, plug in the key and close it. With the meter in position 1, adjust the buffer tuning for maximum grid current (approximately 3-4 mA). Use an rf voltmeter (most VTVM's will work satisfactorily) and adjust the 5-35 pF trimmer until the rf voltage on the grids is equal. Dip the final and tune up normally for a pi section output.

Next switch to phone. There should be approximately 20 mA of idling current. Adjust the buffer tuning for maximum drive. Whistling into the microphone should cause the meter to kick up to approximately 200

mA (depending upon the damping characteristics of the meter).

You are now ready to connect the transmitter to the antenna. I use an antenna tuner that incorporates a TVI filter. For best results look at the rf waveform with an oscilloscope to be sure you aren't overloading on peaks.

. . . W6JTT

Parts not listed on schematic:

L-I $1\frac{1}{2}$ inch of close wound #28 DDC on $\frac{3}{4}$ -inch ceramic form.

L-2 2 inches of close wound #28 DCC on a 1-inch phenolic form center tapped.

L-3 45 turns of #14 solid copper on a 2-inch diameter ceramic form. Turns spaced the width of #14 wire.

C See text.

K-I DPDT antenna changeover relay, 24 Vdc coil.

K-2 DPDT crystal can relay, 24 Vdc coil.

CH Parasitic chokes: 6 turns of #20 solid copper wound on a 47-ohm, I-watt resistor.

T-I 650-0-650 volt, 200 mA, secondary with taps at 200 volts.

T-2 Filament transformer 115 V primary, dual secondary 6.3 V @ 5 amp, 12.6 V @ 2 amp.

T-3 Modulation transformer, 115 V, 400 Hz, primary, 750-0-750 secondary (see text).

Building Blocks

A simple integrated circuit and transistor receiver which tunes from 12 MHz to 18 MHz — it is ideal for many VHF converters.

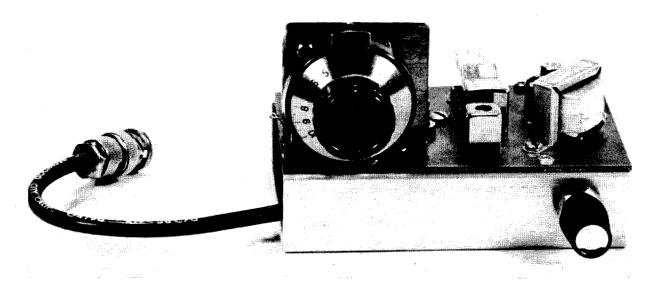
Here is an idea you might like to try. A small receiver, which is suitable for use with most of the myriad of semiconductor converters, can be built for \$20 and the aid of a good junk box. If a receiver is not what you need, there are still some circuits and ideas to suit your fancy.

The use of discrete electronic components is becoming obsolete in cases where a standard circuit is used. Instead, we use assemblies, or integrated circuits, which are usually superior in design to the original approach. As you will see with this receiver, the use of

building blocks is also a means of economizing.

Circuit description

By using an RCA CA3020, which costs \$2.80, I was able to build a quality 500 mW audio system at a price competitive with foreign-made audio assemblies. The *if* amplifier and detector is a Miller 8903. This assembly consists of two units, an 8901 and an 8902, which will provide 55 dB gain at 455 kHz. The cost—\$5.75. My only misgiving on this unit is its frequency. That 910 kHz



SEPTEMBER 1967

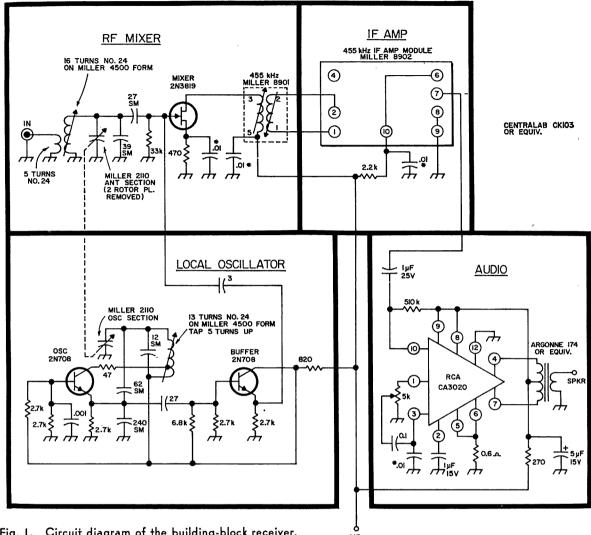


Fig. 1. Circuit diagram of the building-block receiver.

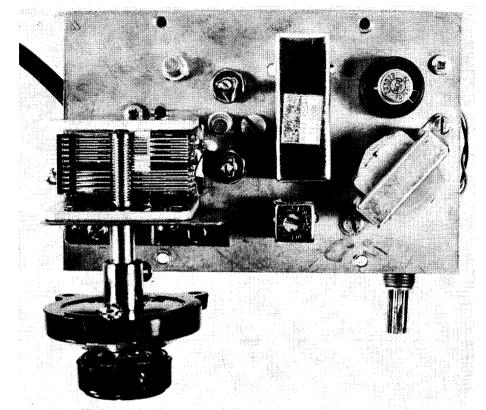
image is a problem when the receiver is used with VHF converters.

After some deliberation, I chose to build the mixer stage with a junction field effect transistor (IFET). The epoxy 2N3819 by Texas Instruments fills the bill for less than \$1.00.

Tuning of this stage, and tracking with the oscillator, provides the only real challenge of the system. The values shown tune from 12 MHz to 18 MHz, but other ranges are easily obtained by changing the tanks. I was able to maintain good tracking with two adjacent rotor plates removed from the antenna section of the tuning capacitor. It was also necessary to bend the outside rotor plates slightly, for good mid-band tracking. Since the transistors are fairly well isolated from the tanks, tracking checks were possible with a grid-dip oscillator with no power applied to the receiver. Slight adjustment of the antenna tank is necessary when power is applied.

If a local oscillator is loaded by the mixer when strong stations are tuned, it will be pulled from its normal frequency. A buffer stage, in the form of an emitter-follower, will overcome that problem. George Daughters, WB6AIG, used a rather elaborate two transistor buffer in his HBR-TR receiver (OST, April 1967), but this seemed unnecessary in the unit described here. I did copy George's oscillator with good results, however. Although the 2N708 was used twice in this circuit, there is really no preference for that type. RCA 40237's, or various plastic types, would be less expensive.

The entire unit was mounted on a 2% x 4% inch piece of PC board, which by luck, almost fits a Bud CB1626 chassis. A good PC board designer might lay out the printed wiring and eliminate the 12-pin socket used



Top view of the building-block receiver showing the location of the components.

for the integrated circuit. Eventually, the receiver will be part of a more classic enclosure. The Argonne 36 mm vernier dial was photographed to show the intended mounting.

Performance

While this may not be the ultimate in modern day receivers, its performance is good. I have used it in conjunction with a 2-meter converter similar to that of K6HMO (73, October 1966). Selectivity is excellent, but the sensitivity might be improved. The JFET does not easily overload; however, it appears to have a minimum threshhold which acts like a squelch.

An earlier attempt used a bipolar mixer which had better sensitivity, plus more noise and overload problems. Despite the problems, some experimenters may find the bipolar type to be preferable.

In all, this circuit satisfied my immediate need for a small, inexpensive, superheterodyne receiver, and it opens new doors for experimentation. Some ideas, which seem practicable using these building blocks as stepping stones, are suggested below:

- 1. A dual conversion system—by adding a 4.5 MHz *if* and crystal oscillator. The RCA CA3022 integrated circuit might be used for the amplifier.
- 2. An rf stage—because of the noise and selectivity characteristics described, a broadband stage might be suitable.
- **3.** A product detector—several transistorized designs have been described recently in 73 *Magazine*.
- 4. A higher power audio system—by substituting an Argonne AR163 for the present output transformer, the CA3020 will drive a power transistor such as the RCA 40250 or the 2N3054.

It is my intention to work on some of these ideas for a new mobile receiver, but I would not be disappointed if you beat me to completion.

. . . WB2EGZ

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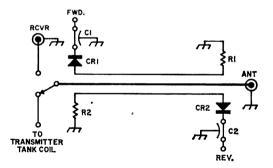
VSWR Supreme

A new construction approach is described here for building a valuable old standby which has found a permanent place in the ham shack of today.

One of the most valuable tools used by the amateur is the Voltage Standing Wave Ratio Meter. It ranks with the grid-dipper and the plate current meter as an indispensable instrument around the ham shack. We know that the VSWR meter is very handy in indicating relative power output when tuning a transmitter, particularly when the plate dip is not too discernable. It is most useful, however, in proving that the last available watt has reached the antenna where it can do some good.

Why a good match?

Although a good copper connection is made all the way to the antenna, an efficient



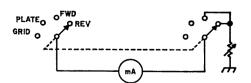


Fig. I Schematic of basic VSWR Meter and associated switching circuits.

transfer of power may not be achieved because of a mismatch between the characteristic impedances of the various portions of the transmission system. The interesting thing is that the "match" is different for each frequency because the antenna is essentially a single frequency device.

We can appreciate the importance of a proper match between the transmitter and the antenna when we are told, for example, that a VSWR of 3 to 1 causes a power loss of nearly 3 dB for 200 feet of RG-8/U coaxial line at 30 MHz. The table below provides the real reason why we should be concerned with the impedance match. Notice how much the transmitter power would have to be increased to make up for a poor match between the transmitter and the antenna. Incidently, this match involves each and every part of the total transmission system including connectors, antenna relay, low-pass filter, balun, etc., as well as the transmission line itself and that particularly critical point at which it is connected to the antenna.

A new approach

Most VSWR meters today are an external accessory to the transmitter. But this practice is not good. Coaxial connectors are expensive and cause unwarranted mismatch and power loss. Meter faces usually end up behind the transmitter or in some other inaccessible location. When switching from forward to reverse, the little accessory box scoots across the table leaving scratches and a distraught operator.

The transmitter plate current meter is no longer a plug-in accessory. Why should the

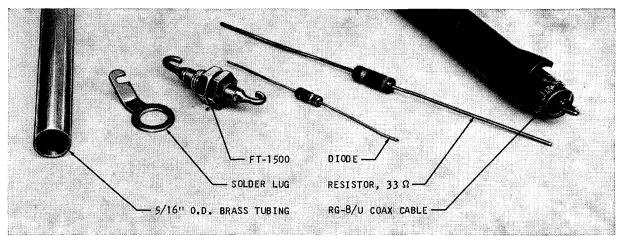


Fig. 2 Component parts used in making the VSWR sensing unit.

VSWR meter be? (Believe it or not, plate meters used to be plugged in with phone jacks.) Using the simple design described here, the home constructor as well as the commercial manufacturer can now build the VSWR meter into the transmitter in the smallest possible space and at only pennies of cost.

The circuit

Nothing is new about the circuit. It has been adequately described in the past in magazine articles and handbooks. However, for the convenience of the reader, the VSWR meter circuit is reproduced in Fig. 1 for handy reference. Terminating resistors R1 and R2 should be 33 ohms for a 50-ohm transmission line when the physical configuration, as shown here, is used. One-half watt or smaller size resistors may be used. Diodes CR1 and CR2 are any matched pair of silicon diodes or germanium. The types which are enclosed in glass cases are the easiest to use because of their small size. The ohmmeter can be used to select and match the diodes

Table	i	Power Loss	Transmitter Power Needed to Provide 1 kW
	VSWR	(dB)	at the Antenna
	1.5:1	2.1	1600 watts
	2:1	2.3	1700
	3:1	2.8	1900
	4:1	3.3	2000
	5:1	3.7	2300
	7:1	4.5	2800
	1:01	5.3	3400

Additional power needed to compensate for a poor impedance match between transmitter and antenna. Figures are based upon 200 feet of RG-8/U cable at 30 MHz.

of the ten-cent surplus variety found in advertisements in the back pages of this issue. Bypass capacitors C1 and C2 are 1500 pF Centralab type FT-1500.

Physical components

Parts used in this VSWR meter are illustrated in Fig. 2. The brass tubing is about 5 to 7 inches long and of 5/16 inch outside diameter. This size tubing fits snugly around the inner polyethelyne insulation from RG-8/U coaxial cable. About 10 inches of coax is stripped of its outer jacket and braid. The inner insulation is trimmed to extend 1/8 inch past each end of the brass tubing. Two large solder lugs are selected to fit over the 1/4 inch threaded shank of the bypass capacitors. These lugs should be of the long variety so they may be shaped and soldered to the brass tubing as shown in Fig. 3. Two 8-inch pieces of #22 enameled copper wire are also required.

Assembly

After soldering the lugs to the brass tubing about % inch in from each end, the bypass capacitors are assembled to the lugs. Place several fiber washers under the ring nuts prior to tightening them down on the threaded shank of the capacitors. This per-

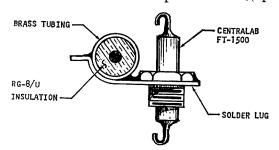


Fig. 3 Solder lug is shaped to fit one-quarter way around the brass tubing.

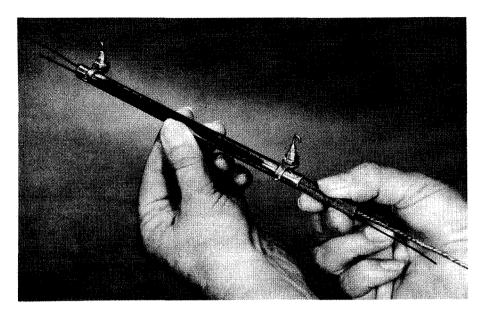


Fig. 4 Assembling the inner components into the brass tubing.

mits careful soldering of the capacitors to the lugs without danger of also soldering the nuts in place.

Two small grooves are now cut 180 degrees apart for the total length of the polyethelyne insulation. A small wood carving gouge or carefully manipulated razor blade can be used for this purpose. These grooves provide a space for the enameled copper wire which is held in place when assembling as shown in Fig. 4. Prior to this operation, the wire should be stretched and work-hardened by jerking it between two pairs of pliers. Be sure that the plane described by the two wires lies at right angles to the chassis on which the unit is mounted. This permits all resistors and diodes to have equal lead lengths.

When the inner assembly has been tugged and shoved into place within the brass tubing, the #22 wire ends are trimmed, stripped and soldered to their respective resistors and diodes. Much care should be exercised at this point to prevent melting the insulation or damaging the near zero-length component leads.

Application

A completed sensing unit for the VSWR meter is shown mounted on a typical chassis in Fig. 5. It will be noted that no conventional box or housing is used because the total outside of the unit is at ground rf and dc potential, save for the component connections at each end. By mounting the bypass capacitor in the chassis, the low-voltage rectified current fed to the meter switch is isolated from high-power rf on the other side of the chassis. It can readily be seen that the finished sensing unit occupies no more space than would be used by a coaxial lead running from an antenna relay to the antenna connector on the chassis.

A further refinement is shown in **Fig. 6**. Complete isolation of the high-power rf is provided by the coaxial hood. Impedance discontinuity is also minimized by use of the hood, which was designed for this purpose and is readily available.

Length of sensor

The dimensions given for the length of the sensor element, including its outer tub-

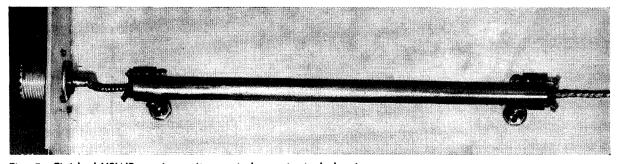


Fig. 5 Finished VSWR sensing unit mounted on a typical chassis.

22

ing and inner conductor, are not critical. They are, however, directly related to the power of the transmitter with which the VSWR meter is used. For example, with a one kilowatt high-frequency CW transmitter and a 0-1 milliammeter as the indicating meter, the length of the sensor can be as short as 2-3 inches. A sensor which is constructed approximately 7 inches long, as illustrated in this article, will work fine with the same meter on a 25-200 watt high frequency transmitter. If meters with higher current ratings are used, a longer sensor is required, and, conversely, a more sensitive meter would provide adequate full-scale deflection with a shorter sensor element. Obviously, it is impracticable to vary the length of the sensor element in order to vary the sensitivity of the VSWR meter as a whole. It is for this reason that the adjusting resistor is provided in series with the meter. For VHF use, the sensor can be shorter.

All that has been said above can be depicted graphically. Fig. 7 shows the generalized relationship between the sensor length and transmitter power with which it is used. The two curves represent different meter sensitivities. A 0-1 milliammeter offers a good compromise. With a 5-7 inch long sensor and the proper series resistor, all powers normally encountered in amateur work can be handled. However, if space requirements so dictate, a shorter sensor unit can be employed with some small sacrifice in accuracy.

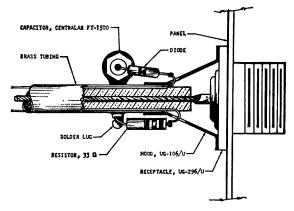


Fig. 6 Recommended chassis connection for output of VSWR meter sensing unit.

Terminating resistor

Small variations in mechanical construction and lead dress will have an effect on the value of the terminating resistors, R₁ and R₂. Also, a carbon resistor does not display the same reactance at high frequencies as its measured resistance at dc. The value of the 33-ohm resistor was therefore determined empirically.

To verify the proper value of the terminating resistors, the test set-up shown in Fig. 8 is used. A radio-frequency source of approximately 10 to 20 watts is required. A transmitter exciter stage operating on the 10-meter band is preferred for this purpose. Ten meters, or even fifteen meters, will provide better accuracy than one of the lower

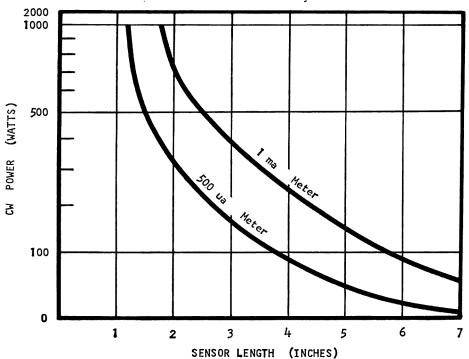


Fig. 7 The approximate relationship between sensor length and transmitter power is shown for two commonly used meter movements. Other meter values may be used as discussed in the text.

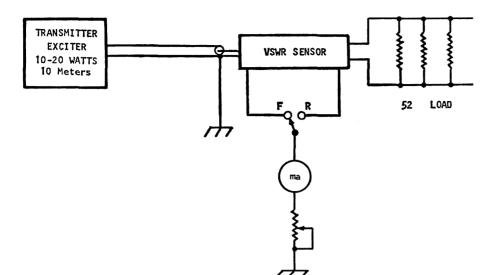


Fig. 8 Test set-up for verifying the proper value of the terminating resistors which are a part of the sensor unit. The value of the dummy load should match the characteristic impedance of the sensor unit and have a total wattage rating nearly equal to the source power.

frequency bands. A dummy load is also required. This load must be capable of dissipating the power of the radio-frequency source used in making the test. Three or four 2-watt carbon resistors of the proper value in parallel to provide 52 ohms will suffice if the power is not left on continuously.

In making the test, the selector switch is first placed in the "forward" position. With power applied, immediately adjust the sensitivity control so that the meter reads full scale. Upon switching to the "reverse" position, the meter should read near zero and be at or below the 1:1 calibration point on the meter scale. Several resistors may be substituted until the proper value is found. The important thing to remember is that both of

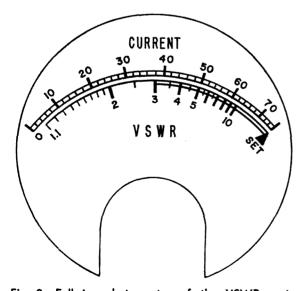


Fig. 9 Full-size photomaster of the VSWR meter dial. A multi-purpose meter was used in the author's transmitter so that the grid and plate currents could also be read on the upper scale.

the resistors should be simultaneously substituted and that they must be as near identical as possible as measured on a reasonably good ohmeter. Lead lengths should also be as short as possible and of identical length.

The dial scale

Using the standard formula for calculating VSWR, it is possible to calibrate the meter face as follows:

$$VSWR = \frac{forward + reverse}{forward - reverse}$$

Fig. 9 is a full-scale illustration of a meter face used with the VSWR Supreme. This scale fits the Triplett Model 327, as well as a number of other meters of the same size category. A word of caution—don't assume that the scale calibration, or linearity will be the same for all makes of meters. The individual meter movement selected should be checked by using the above formula and marking off radials representing 4-5 different VSWR values. With the scale from your meter at the center of an oversized radial(s) drawing, it is possible to verify the angular placement of each VSWR calibration point.

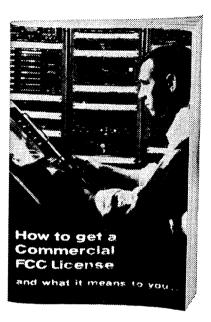
The VSWR Supreme is truly a novel approach to an old standby. Using the construction methods outlined in this article, it is possible to fabricate the sensor unit so that it occupies the smallest possible space. This sensor can now be built into a transmitter and take up no more room than the coaxial lead which it replaces.

. . . W4BRS

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Dual-Band Use of Single-Band Beams

W2EEY describes several ways the driven element of a single-band beam can be used on a higher frequency band without affecting beam performance on the band for which the beam is designed.

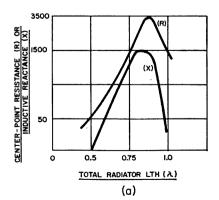
With the number of sunspots rapidly growing, many amateurs want to be able to use their present antennas on a higher band. Particularly, those with a 20-meter beam with a center-fed driven element might desire to have a radiator available on 15 or 10 meters and those with a 15-meter beam to have a 10 meter capability.

The purpose of this article is to present some simple ideas on how the center-fed driven element of a beam can be converted for use as an effective radiator on a higher band without in any way affecting performance on the basic band. Only the driven element is effected; no attempt is made to convert the entire beam to a dual-band affair. Methods of making dual-band beams have been well described before and the simple

conversions mentioned in this article are meant only to give capability on a higher band perhaps as a preliminary step to later erecting another beam.

Basically, all that is done is to use the half-wave driven element as a three-quarter or full-wave element on a higher band with a simplified feed system. The three-quarter and full wave dipoles have a very minor amount of gain (about 1 to 2 dB), but the directivity is enough to make rotation worthwhile. With the exception mentioned later, a 20 or 15 meter wire dipole can also be converted for use as a dual-band antenna.

As shown in Fig. 1, as the ratio of the diameter of a linear conductor from which an antenna is constructed increases as compared to wavelength, the characteristics of the in-



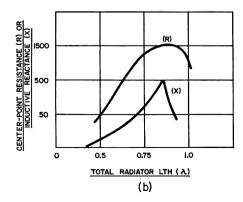


Fig. 1. The center-point impedance of a radiator for wavelength/conductor diameter ratios of $\lambda/1000$ (a) and $\lambda/100$ (b).

put impedance change. The resistive portion of the feed point impedance decreases in value and the peaks of the response broaden out. The reactive portion of the impedance decreases even more rapidly than the resistive portion and exhibits a sharper peak. There are also shifts in the exact radiator wavelength values at which the peaks occur but these are minor for the two wavelength/conductor ratios considered $-\lambda/100$ and $\lambda/1000$.

Most of the tubing used for beam construction on 20 and 15 meters will have wavelength/diameter ratios between these two extremes. Single wire antennas will have higher ratios—approximately $\lambda/10,000$ for number 14 wire. In order to utilize the dualband feed system mentioned in this article, the ratio must be reduced by using two or more wires on each side of the dipole which are fanned out to at least a foot separation between them at the ends.

Matching a transmission line to the impedance presented at the center point of a dipole which is ½ wave long on one band and 34 wave long on another band can be done in several ways. A double stub matching system can be used to produce an almost exact match to a transmission line on two bands but the adjustment procedure is unduly tedious, especially for the amateur who wants just occasional usage of an antenna on a higher band. The matching system actually used is a simple quarter-wave linear transmission line transformer. Such a transformer will not cancel the inductive reactance which a % center fed dipole presents. It can only match a transmission line to the resistive portion of the antenna impedance. However, as the wavelength/diameter ratio becomes reasonably large, the reactive portion of the impedance comes down to a value which can be accepted by most transmitter output circuits and the SWR will be a reasonable value on the higher band.

Fig. 2 shows a 15-meter dipole which can also be used on 10 meters. Since the match ing section is cut to $\frac{1}{2}$ wavelength on 15 meters, the antenna terminals see exactly the same impedance as the coaxial transmission line and 15 meter performance is not changed in any manner. On 10 meters the matching section becomes approximately $\frac{3}{4}$ wave long (actually .7 λ on 28,500 kHz when cut to .5 λ on 21,000 kHz). The somewhat shortened length presents some capacitive reactance to

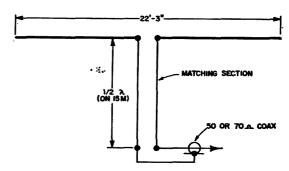


Fig. 2. A 15-meter dipole with a matching section for use on 10 meters. The impedance of the matching section depends upon the physical characteristics of the antenna as explained in the text.

the antenna terminals and seems to partly compensate for the inductive reactance of the $\frac{3}{4}$ λ long flat-top on ten.

The impedance of the matching section is determined from the standard formula:

$$Z = \sqrt{Z (coax) \times Z (ant)}$$
.

The impedance of the antenna on 10 meters can be estimated from Fig. 1 by taking the average antenna conductor diameter to estimate the wavelength/diameter ratio. For instance, for an average diameter of one inch, a matching section of 300 ohms would be used to match the approximate 2,000 ohm input impedance. In most cases, a 150 or 300 ohm matching section will suffice for the range of impedance encountered to produce a SWR of 2 to 1 or less on the higher band. The physical length of the matching section must take into account the velocity factor of the transmission line used (for instance, a ½ \(\lambda\) line of 300 ohm twinlead on 15 meters would be 17'2").

Using a 20 meter driven element on 15 meters presents almost exactly the same situation except that a ½ wave matching section on 14,000 kHz becomes almost exactly ¾ wave on 21,000 kHz and no effective com-

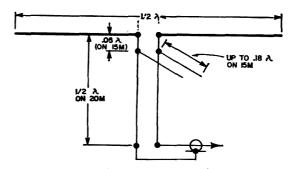


Fig. 3. The use of a 20-meter dipole on 15 meters may require the use of a small capacitive stub across the matching section.

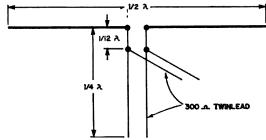


Fig. 4. Using a 20-meter dipole on 10 meters by matching with a $\frac{1}{4}$ λ stub. The 300-ohm twinlead to the transmitter can be replaced with coaxial cable if a 4:1 wideband balun is used where the twinlead is attached to the stub.

pensation is provided for the reactive portion of the antenna impedance on 15 meters. Whether the reactance is sufficient to cause tuning difficulties depends upon the exact installation and operation of the transmitter output circuit. If difficulties are encountered, a stub of the same type line as the matching section can be added to the matching section as shown in Fig. 3 and trimmed for proper tuning. The position of the stub is not exactly correct as shown, but will suffice in most cases where antenna operation must not be effected on the fundamental frequency.

The use of a 20 meter dipole element on 10 meters cannot be accomplished by the use of a simple through-line ½ wave transmission line transformer because of the even multiple harmonic relationship of the two bands. Again, there would be various possibilities to match the antenna to the transmission line by use of multiple stub arrangements. However, the easiest scheme is an old one from the 1930's which gained popularity as a multiband antenna matching method, long before trap antennas were popularized.

A quarter-wave open stub is connected to the center of a half-wave dipole and the transmission line is connected across the stub one third the distance along it from the antenna. If the voltage and current distribu-

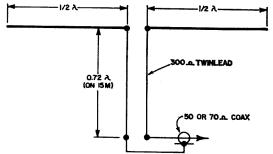


Fig. 5. A full-wave antenna for 15 meters can also be used on 10 meters if a 0.72 λ matching section is used.

tions are drawn, it will be seen that almost the same impedance is presented at the one third point for the fundamental and all even harmonic frequencies; certainly for the fundamental and second harmonic, they are the same. Fig. 4 shows the arrangement using a 300 ohm transmission line. It should be noted that since essentially no reactance is present at the antenna terminals, the considerations regarding wavelength/conductor diameter ratio are not as important as in the previous matching methods.

A relatively simple matching system for a full-wave wire antenna for use on 15 and 10 meters can also be developed using a transmission line transformer in a fashion similar to our first scheme. Fig. 5 shows the matching arrangement. The matching section is cut slightly shorter than 34 wavelength on 15 meters and acts as a ¼ wave transformer to match the low coaxial cable impedance to the high center impedance of the full-wave antenna. On 10 meters, the antenna flat-top portion becomes 3/2 \(\lambda\) long and the matching section is essentially 1 λ long. Since the latter is a multiple of $\frac{1}{2}\lambda$, the low center impedance of the $3/2 \lambda$ flat-top is reflected directly to the coaxial transmission line.

It should be noted that although the $^{3}\!4~\lambda$ matching section performs as a $^{1}\!4~\lambda$ transformer ($^{1}\!2~\lambda$ section which performs no impedance transformation plus a $^{1}\!4~\lambda$ section which acts as the transformer), a $^{1}\!4~\lambda$ matching section cannot be used directly on the 10 meter band because its length (.35 $^{\lambda}$) would not be close enough to $^{1}\!2~\lambda$ to be suitable.

It should also be noted that since this antenna is $3/2 \lambda$ long on 10 meters, the horizontal radiation pattern changes from a maximum lobe broadside to the wire to a cloverleaf pattern. This is in contrast to the previously described antenna systems which produce a maximum length of 1λ so that a collinear array of two $\frac{1}{2} \lambda$ elements was formed and maximum radiation remained broadside to the antenna, the same as for a $\frac{1}{2} \lambda$ dipole.

The ideas presented in this article are not really new since transmission line transformers and stubs have been used for multiband antennas since the early 1920's. However, these ideas should enable most amateurs to at least quickly and simply provide themselves with a dual-band antenna from a simple one-band dipole.

... W2EEY/1

Grounded-Grid Filament Chokes

Designing high-current rf filament chokes for groundedgrid amplifiers.

The grounded-grid amplifier is proving very popular with the ham fraternity for the amplification of SSB signals. An amplifier of this type is characterized by a comparatively low input impedance and relatively high driving power. Most SSB exciters in use to-day meet these requirements with ease, generally having a 50-ohm output at 100 watts or more. A disadvantage of the grounded-grid circuit is that the filament must be isolated for rf from ground.

Fig. 1 is a typical grounded-grid input circuit. Since the filament of the groundedgrid amplifier tube must operate at a rf potential above ground, it is necessary to isolate the filament from the transformer. A popular method of accomplishing this isolation is to place an rf choke between the tube filaments and the filament transformer.

In the construction of a choke for this application, the inductance of the choke must be such that the reactance is several times the input impedance. If the amplifier input is 50 ohms, the reactance of the choke should be about 250 ohms at the lowest operating frequency. The choke conductor must be large enough to carry filament current without excessive voltage drop. In addition, the choke must not have series-resonance points at any of the operating frequencies.



The complete bifilar wound, grounded - grid filament choke is on the right. From left to right respectively are the ferrite core, the bifilar-wound-coil and the heat-shrinkable tubing used for the outer cover.

Photograph by Bob Fleischman WA6WFE

The minimum required inductance can be calculated from the inductive reactance equation:

L =
$$\frac{X_L}{2\pi F}$$

Where: $2\pi = 6.28$
F = 3.5×10^6 (3.5 MHz)
 $X_L = 250$ (desired reactance)
L = $\frac{250}{6.28 \times 3.5 \times 106}$ = 11.3 μ H

The first requirement is to produce a coil having an inductance of 11.3 microhenries.

Before proceeding with winding the choke, it is necessary to determine the required wire size. This is based on the filament current. As an example, consider the 3-1000Z tube that requires 7.5 volts at 21 amperes. It can be seen that if 21 amperes flows through any appreciable resistance, considerable voltage loss will occur. In this case for example, one tenth of an ohm resistance will result in a voltage drop of 2.1 voltsthis would result in only 5.4 volts at the filament terminals. The RCA transmitting tube manual indicates that operating voltages applied to the filaments should not be allowed to vary more than 5% from the specified values. It is best to operate the filaments as close to the specified value as possible. Using a 0.25 volt drop across the choke as an acceptable value, the resistance of the choke must not exceed .012 ohms. A copper wire table shows that number 10 wire has a resistance of 1.018 ohms per 1000 feet or .001 ohms per foot. If a choke is wound with 8 feet of number 12, the resistance would be .0128 ohms (8 x .0016) which slightly exceeds the required .012 ohms. It would be best to select number 10 wire where 8 feet would exhibit .008 ohms. A .008 ohm choke (dc resistance) with 21 amperes flowing through it would result in a voltage drop of .168 volts.

From Fig. 1, it may be noted that two rf chokes are required. These can be separate rf chokes, or they may be bifilar wound with both coils on the same form. The accepted practice has been to use a bifilar winding. Fig. 2 illustrates a section of a bifilar wound coil. Note that the turns are wound parallel to each other around the form. The eight feet of wire is divided into two four-foot lengths and wound on some convenient form. For example, if the coil is wound on ½ inch dowel rod, two four-foot lengths of wire (bifilar wound) will produce two coils, each

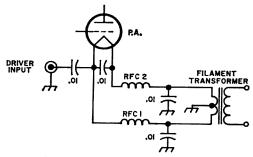


Fig. 1. Isolating the heated cathode of a groundedgrid rf amplifier with filament chokes RFC1 and RFC2.

having 23 turns with a coil length of 4.75 inches. However, a coil with these dimensions will have an inductance of only 1.5 μ H, far from the required 11.3 μ H.

Some means of increasing the inductance of the coil must be provided. This can be accomplished by removing the coil from the ½ inch dowel rod and slipping the coil over a ½ inch ferrite rod.¹ When a ½ inch ferrite rod is inserted into the coil, the inductance is increased to approximately 20 µH. The inductance can be determined by locating a resonant frequency of one of the coils with a known capacitor connected across the coil. With a 36 pF capacitor across the coil, a GDO indicated a resonant frequency of 6.0 MHz. This frequency can be inserted into the equation:

 $L = 25330/F^2C = 25330/(6^2 \text{ x } 36) = 19.4 \ \mu\text{H}.$

Where F is MHz and C in pF.

Ferrite rod is quite hard and cannot be cut with a hacksaw. If it is desired to cut the rod, one method is to take a three-cornered file and file a small groove around the rod, place the rod in a vise with the groove at the edge, and with a quick hand motion, snap the rod off.

 1 Lafayette part number 32C6103, page 248, 1967 catalog.

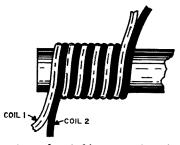


Fig. 2. Section of a bifilar wound coil. Note that the turns are wound parallel to each other around the form.

A check of the rf choke should be made to assure that no series-resonance points occur at the desired operating frequencies. It will be remembered that in a series-resonance circuit the inductive reactance and the capacitive reactance cancel, and the only impedance in the circuit is the dc resistance.

Since maximum current will flow in a series-resonant circuit, it is necessary to know that no series resonances occur at any of the operating frequencies. These may be determined by shorting the coil with a short piece of wire and checking with A GDO from 3 to 40 MHz for dips. A test of the rf choke shown in the photograph indicated no series-resonance points when tested on the bench or installed in a grounded-grid amplifier.

Although not required, the choke shown is protected with a length of ¾ inch shrink-fit tubing." If the coil does not fit snugly around

the ferrite core, place a few drops of adhesive on the core before slipping it into the coil. If shrink-fit tubing is used, it will hold the core in the coil.

The choke may be installed by soldering the choke leads directly to the filament transformer terminals at the tube socket or the choke may be mounted on tie points and then wired to the filament transformer and tube sockets. Wiring should be kept as short as possible and all excess transformer leads cut off to reduce introduction of additional resistance into the circuit.

One final point—in the event that the correct wire size cannot be obtained, the coil can be wound with a smaller size wire and the filament transformer voltage raised to compensate for the additional voltage drop in the choke.

. . . W6RET

² Beldon part number 68082,

DL410-3690

When out motoring on our streets and highways, I see many other cars with mobile antennas swaying to and fro. Probably these fellows would like to have a QSO, but then comes the big question, does he have the rig turned on, and if so, where is he tuning? Many clubs and communities have a sign on the city limits stating the calling frequencies for mobile units in that area. This is a very good idea. My wife and I took a trip through 37 of our United States in 1963 and made good use of these signs.

Getting back to the mobileer, how can you figure out where he is tuning? Often you can tell what band is being worked by the size and shape of the mobile whip or coil. Unfortunately, many of the newer antennas look the same regardless of the band they're used on! Also, when you are whizzing along the freeway at over 60 miles per, its pretty tough to inspect the other fellow's antenna coil.

Over the years I have developed a method of getting around all this guess work. This is to have a little sign that can be mounted both on the front and back of my car which contains only two lines of simple instructions—my call letters and the exact frequency that I monitor. When just buzzing around locally I keep the sign on the rear. If out on a longer trip both front and rear. I have

used painted signs on heavy cardboard for use inside the windows of the car, and more elaborate sheet metal signs which may be attached with wingnuts. The one I use now can be reversed so that one side says, "DL4IO 3690", and on the other side, "DL4IO 28500". You can put whatever you want on the sign, but it's best to keep it simple and to the point. Sometimes the other guy only sees it for a few seconds. My present sign uses three inch high letters and numbers made out of reflector tape. This makes it easier to see at night.

Once you have calling information posted on your car, results should not be long in coming. It's especially useful when away from home in strange territory. It helps fellows with the fixed stations, too. Just recently, while driving through a small village here in Germany, I saw a bicycle rider look at our car, do a double take and peddle off madly around the corner behind us. Not many minutes later there came a call on my monitored frequency from this same young fellow who had passed us on the street. He was very much out of breath from racing home and then running up four flights of steps to the ham shack. He elaborated at great length on how happy he was to see my sign and then make a QSO.

... Ken Bale W7VCB/DL4IO

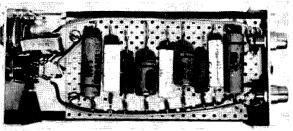
200 Hertz CW Filter

A receiver with selectivity of 150 or 200 Hz should appeal to most CW hams. You can add this to your present receiver for a small sum and without any alterations. The filter shown here is connected between the 500-ohm output and your headphones. A by-pass switch is all that is needed, to cut it in or out as you wish.

The tonal quality of the received signal is only slightly sharper than the narrowest setting of the receiver. Background noise is attenuated considerably. Tuning will require a little more care, and in some cases the BFO may have to be peaked to the filter's center frequency. The selectivity of the receiver can be left in any setting.

There is a 3-dB loss through the filter, equivalent to one-half S-unit. Because of the lower background noise, weak DX signals can be heard, but require amplification to be worked. Also, individuals using a speaker will need an amplifier. It would probably be best to try out the filter as described and if found satisfactory, fit it to your requirements.

This filter is of the symmetrical type; that is, one half of it is a duplicate of the other. It has a bandwidth of 160 and 600 Hz at the 3 dB and 30 dB attenua-



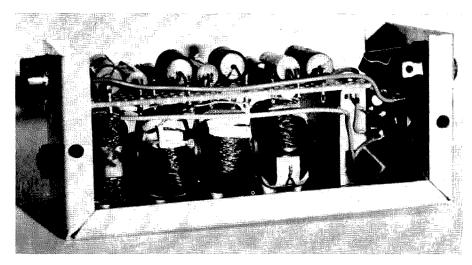
Top view of the 200 Hz CW filter. The ground connection for the capacitors goes to the soldering lug on the left, which is fastened to the aluminum support angle.

tion points, respectively. Its center frequency is set at 1000 Hz and it has an impedance of 500 ohms. Four 88 mH toroids of the unpotted type, and nine paper or mylar capacitors make up the filter. Mounting of the toroids is optional, but about one-quarter inch clearance must be allowed between each inductor and surrounding objects to prevent a change in their inductance.

If a different center frequency is desired, the capacitance values must be changed accordingly, assuming the toroids are untouched. The Q of the network will lower slightly as the center frequency is reduced.

At the indicated frequency, the reactance of these toroids is 553 ohms, giving C as

The 200 Hz CW filter is mounted in a 5 x $2\frac{1}{2}$ x $2\frac{1}{2}$ minibox. The 88 mH toroids are mounted on a threaded nylon rod; rubber grommets are used for spacers. The capacitors are mounted on a piece of punched Vector board.



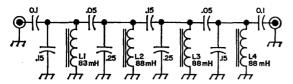


Fig. 1. Circuit of the 200 Hz CW filter. The coils are surplus 88 mH units. The capacitors were selected to proper passband response.

Attenuation	Bandwidth—Hertz		
3 dB	160		
6 dB	210		
12 dB	260		
18 qB	350		
24 dB	460		
30 AB	600		

Passband response of the symmetrical type 200 Hz CW on a center frequency of 1000 Hz with input and output impedance of 500 ohms.

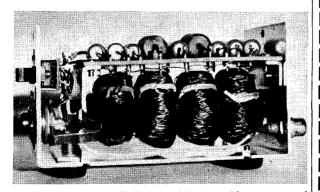
 $0.28 \mu F$. This value can be compared with Fig. 1. A signal generator and scope was used to determine the other capacitors, taking one toroid section at a time. Both the input and output were loaded by 500-ohm resistors during these tests.

The response curve of the first section will appear much like that of an if transformer. The two peaks will merge as more sections are added and sharpening of the skirts will be noted. Incorrect adjustment may cause one peak to "slide" down the slope instead, setting up two resonant points with resultant sub-harmonics. No further attenuation was obtained beyond four sections.

Due to the wide tolerance of capacitors, the values shown in the diagram must be considered as only nominal values. If a scope is not available, tests can be conducted with a VTVM.

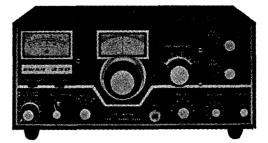
This filter will add an additional selectivity position to your receiver and provide more enjoyable CW operation.

. . K7UDL



Compact version of the 200 Hz CW filter mounted in a minibox four inches long. The lugs on the slide switch had to be bent over to provide clearance.

METER TRANSCEIVER

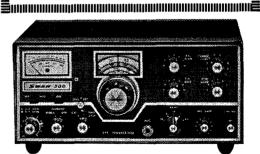


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Observations of note by a VHF addict

Have you ever wondered where that #&\$%& is who gets so many sections and contacts? Especially while the band is dead at your QTH?? Take heart and read, VHF'er. I will try to clue you in on most of the suitable places in San Diego Country (the best coverage, since my QTH is there) and other counties' mountains of note.

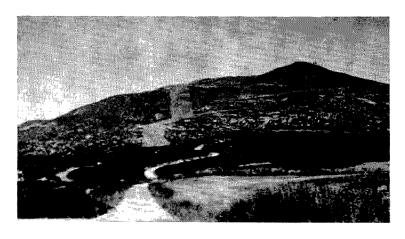
Since I am not particular on the elevation, so long as the propagation is good, I will include many small hills that are easy to get to and are of particular interest.

A little known mountain in San Diego County is Hot Springs Mountain. It is THE tallest mountain in San Diego County. It is 6533 ft. high and propagation is very good there. Communication with Arizona is easy since it is almost line-of-sight. Nevada is easy, also, although it would be wise to arrange skeds. Its location is just east of Warner Springs. To get to the top, which is usually locked, one would have to contact the U. S. Forestry District (Palomar) Office in Escondido, California. The road is not extremely dangerous, but it isn't particularly easy either. One hinderence about Hot Springs Mt. is that you would have

to turn your beam to work San Diego decently.

Another well-known mountain is Tecate, 3985 ft. high. This has a lot of nicities that Hot Springs lacks. Of course, propagation to the east and north east is diminished. Tecate Mtn. (state lookout) is located on the border, in fact, 1/3 is in Old Mexico. To get there, one would take highway (state) 94 east to the Tecate Turnoff, take the turnoff, and proceed until (about 2 miles) you see a sign saying Tecate Mtn. Lookout. Take it all the way. One word of caution: at the farm, at the very foot of the mountain, there are several dogs that just plain don't like hams. Keep doors and windows closed. If you want to go up outside of the fire season, you will have to get the key from the State Forestry District Office, in La Mesa. Tecate is one of my favorites. Once you get on top, you have a clear shot to L.A. and north. You set your beam towards L.A., and it's easy to work San Diego, slightly off to the side. On top, water is available and there is even a cement walkway to a nice facility.

Another well-known mountain is Lyons, just about 5-10 miles north of Tecate. It



Tacate Mountain — 3985 feet high. This mountain is located just north of the Mexican border in southern California. The "painted" mark to the left in the photo delineates the U.S.-Mexican border.

is surprising how useless this mountain is to VHF contesters. There are repeaters all over the summit. CD 2-meter phone closed-circuit stuff, etc. Also a person does not have as nice a shot north for L.A., etc. If you still want to go, you had better inquire at the U.S. District Forestry Station at Descanso, California.

One of the best mountains in San Diego County to go north is Mt. Otay. It is directly east of my QTH, north-west by west of Tecate. It is apx. 3600 ft. It has no facilities—bring your own water, etc. This is about the best mountain for S.D. and L.A. etc. work. It is pure line of sight for everything. It is leased privately, and it isn't easy to get the key. Inquire at the State Forestry Office in La Mesa.

A mountain known to just about every-body as Broucher Hill Lookout is fair for 6 and up work. It is on Palomar mountain, and if you have enough ops to post a couple as guards, you have it made. Another disadvantage is that if your beam is pointed to L.A., then you're 180° out from San Diego.

Cuyamaca Mountain is known herebouts for snow in the winter time. I believe its elevation is about 5000 ft. It is also used as a repeater sight, but the real bugaboo is the Air Force radar installation there that causes images.

Los Pinos Mountain is about 7 miles south east of Cuyamaca, and about 500 ft. below. It isn't very good for L.A. communications for that reason. It gets quite cold on this one also.

Others in San Diego that you might want to check out are High Point and Black Mountain. They're U.S. Forestry lookouts, so inquire in Palomar District HQ, in Escondido.

Others of lesser note are Margarita, Woodson and Red Mountain lookout points. These are not recommended for various reasons.

Some mountains that one can drive up and operate mobile with very good results are Cowels, (I question my spelling) Helix, and Soledad. These are very good for evening operation.

Other very good mountain operating points in Southern California are Santiago (Riverside Cty): Santa Rosa Pk, 8046, (Riverside Cty), Pacifice Mtn., 7124 ft., (L.A. Cty), Mt. Lowe 5593, (L.A. Cty) and Mt. Wilson,—ft, (L.A. Cty). Mt. Frazier, 8013

and Pines 8826, are both in Ventura County, with real good chance of getting Santa Clara Valley and San Joaquin Valley.

Well, now that I have given you an idea where everything is, I'll just comment about what to bring, and how.

If you intend to do a little hilltoping-GO PREPARED (voice of sad experience) PLAN EVERYTHING in advance, Murphy's Law and Harris' Theorem are infamous on these trips (I know). It isn't advisable to use tents. In the winter of 63-64, the roof of Tecate Lookout was blown off. And it wasn't put on with just glue either. Winds, at night, can very often get up to the hairy point . . . but a little danger adds zest in one's life. The best operating shack would be a camper or station wagon. Make sure your car's full of water. An engine can really over heat on some of those climbs. Coffee: bring batches of it. Surprising how it perks one's spirit, and cold toes. Antennas . . . bring the least wind resistant one you have . . . that's any good. Don't sweat about a mast . . . Get a broomstick and pound it in the rock-soil. You have a high enough mast under you anyhow. But do secure it. It's death if your big beautiful beam plunges off the side. (sob-voice of experience).

I hope some of you are interested. If you want to hilltop, you can get information from various sources-fellow hams . . . gas station attendants, and forestry officials. A word to the wise . . . be nice and courteous. Ask politely for the use of the mountain, etc. If you belong to CD, you might drop a couple hints about possible emergency tests-show him your license and CD card. But the best asset you have is to be kind and polite. I know. Most people think that teenagers are mostly brats or hoods. But even so, I have been able to get to many "no trespassing" places because I was polite. Also, leave EVERY-THING the way you found it. Remember, you might wish to come again. The ranger might not appreciate soda-beer cans all over the place, etc., and might put you on the "black" list.

Everybody is welcome and everybody has fun, so get out your gooney box and get on when there is a VHF contest. You'll be surprised how much activity there is and maybe you'll start hilltoping in earnest.

... WB6ILC

Mobile Installations

The effect of SSB on battery drain and feed resistance

In discussing mobile operations, the question of battery drain usually rises very quickly. The prospective mobile operator is naturally concerned with the drain on his battery. He fully realizes that while the car is in motion the battery will be charged, but how long can he operate at a stand-still?

One answer is, of course, that he can keep the engine running; and the development of alternators has facilitated this problem since they are capable of producing high charging currents at low engine revs. Nevertheless, many amateurs would rather operate when stationary without the engine running.

It is, of course, now possible to fit two batteries and by means of blocking diodes, reserve one for the radio and one for the car so that one will not be stranded with a flat battery unable to start the car. Still, the question arises, how long can one operate at a standstill on one battery without the engine running? This is where SSB is such a tremendous contribution to mobile operation. The duty cycle of SSB is so short that the average battery consumption bears little relation to the peak consumption.

To understand exactly what is meant by the short duty cycle, we have only to cast our minds back to amplitude modulation and to the various clippers and compressors which were developed to realize that speech consists of very high peaks of extremely short duration which far exceed the average amplitude.

When using AM from a mobile rig, the battery drain was continuous throughout the period of transmission in order to provide the carrier. The amplitude rose on positive peaks by as much as it fell on negative peaks but the average was the power required by carrier, and was continuous throughout the whole period of transmission.

SSB has removed the carrier. Now the power drain reaches its peaks only on the peaks of modulation. These only represent a very short time during normal speaking. The average power is very much lower than the peak power and, furthermore, any break between words or even between syllables instantaneously reduces the power required to very much lower levels. This has enabled reasonably high-power transmitters to be operated on SSB for considerable periods without flattening the battery.

I find that I can operate for 1½ to 2 hours with normal periods of transmission or reception with the Drake TR3 or TR4 on a normally good-sized car battery. Unfortunately, there is another side to the question. The current requirements during short periods can be quite high on the modern transceivers and though, as explained above, this does not seriously increase the battery drain, it does mean that the current flowing at certain periods from the battery to the mobile power supply is high and mobile installations must take this into account if good mobile communications are to be maintained.

I was recently told on several occasions that my signal was not as strong as it usually is. Cursory examination of the transceiver and antenna, etc. did not disclose any obvious fault; the only symptom was that the rig didn't load as it had in the past. With the assistance of a friend and a voltmeter, the following tests were carried out:

The voltage at the battery terminals was measured with the transceiver in "transmit", carrier inserted, and this was compared with the voltage under similar conditions at the input terminals of the power supply. A drop of 1½ volts was noted between the battery terminals and the input terminals of the power supply. If we assume a current of

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30 amps at that moment, this would mean that the voltage drop was due to a resistance of one-twentieth of an ohm, or $0.05~\Omega$, not exactly an enormously high resistance for the total of the contact resistances and the wire. If we assume that the current was only 20 amps, this would have made a resistance of 0.075 ohms, still not a very high resistance, but enough to materially detract from the performance of the transmitter.

By making certain alterations in the wiring, it was possible to achieve a voltage drop of only half a volt (still quite considerable) between the battery terminals and the input to the mobile power supply. This would mean a resistance of 0.025 ohns of one-fortieth of an ohm on a 20 amp load. On a 30 amp load it indicates a resistance of less than 0.017, or about one-sixtieth of an ohm. This resistance must cover the total resistance of the wire—both leads, positive and negative plus any contact resistance involved.

This gives some idea of the resistance in which **G**e are interested when feeding a mobile power supply from a battery. It may help to explain why some mobile operators find difficulty in working over reasonably long distances from their mobile installations. It is certainly a factor which must be borne in mind when dealing with mobile installations.

. . . G3BID

Stolen Equipment

Recently the Stanford Radio Club Station, W6YX, was broken into, and the following pieces of Collins Radio equipment were stolen:

Type	Description	Serial No.
32S-1	Transmitter	10790
75S-1	Receiver	3018
312B-4	Station Control	293
516F-2	Power Supply	3611
75A4	Receiver	5091

The cabinets of the S-line equipment were sprayed with red and orange paint. The 74A4 receiver had homebuilt crystal filters in place of the mechanical filters.

If you should have any information on the whereabouts of this equipment, please contact Victor R. Frank, Research Associate, Stanford Electronic Laboratories, Radioscience Laboratory, Stanford, California.

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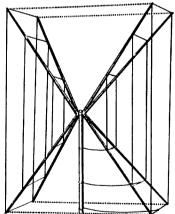
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Getting a Start in Amateur Television

If you have been thinking about getting on ATV, this article outlines some of the simple techniques that can be used for getting started.

No matter what it is you would like to do, the biggest problem is always to overcome your own inertia and get started on the project. A great many amateurs, especially those who work the VHF bands, profess an interest in amateur television (ATV). Unfortunately, there always seems to be a host of problems, both real and imagined, which eventually prevent them from starting to actively experiment with this fascinating aspect of amateur radio. The purpose of this article will be to take a look at some of the problems and requirements facing the newcomer in ATV, and perhaps after we've thrown a little light on the subject, they won't seem quite so imposing.

Once you know the kind of equipment you need, one of the biggest problems is where

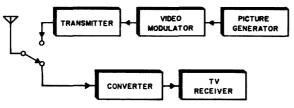


Fig. 1. Block diagram of the units required for a basic ATV station.

to go to find the information needed to put it together. The kind of references you need to make a start are available, but most amateurs don't know how to go about finding them. This article will have two purposes—first, to give you an idea of what you will need in the way of equipment, and secondly, to indicate where you can get the information you require. Each time we mention a specialized piece of equipment, you will find a number, referring to a reference at the end of the article, which should serve to get you moving in the right direction.

Unlike the situation in many areas of our hobby, you don't go out and buy items of chrome-plated equipment, bring them home with a few pieces of connecting cable, and suddenly find yourself on TV. ATV and a few other areas, such as RTTY, are still dominated by homebrew equipment. There are two basic reasons for this. First, there is a lack of amateur grade equipment on the market, and secondly, there is the cost factor. If you haven't already discovered that you can build a good piece of equipment for considerably less than its market value, you still have a lot to learn about this hobby of ours! This doesn't mean, however, that you have

to be an electronic genius to get on the air. There are simple circuits that are good for getting your feet wet, and more complex pieces of gear which can be tackled after a little experience. How many of us would be in amateur radio if we had to start by scratch building a SSB transceiver? Even the renowned "old timers" in this hobby started with crystal sets and regenerative receivers. The situation is quite similar with ATV. To generate the best possible signal using any mode requires sophisticated equipment, but this doesn't mean that you have to start that way. A lot of fellows have started in ATV, only to quit because they tried to begin too far up the ladder. You learn by moving up the ladder, and, in any area of the hobby, the guys who never learn anything are often the ones who start at the top with the storebought goodies.

Fig. 1 shows a block diagram of a basic ATV system. The logical place to start our discussion is at the receiving end, particularly if you live in an area that may already have ATV activity. The TV receiver is the easiest part, for virtually any standard set will do the job. Generally the newer sets are more sensitive, and hence more desirable than some of the old clunkers. Most TV shops have a pretty good stock of used sets. Very often these sets are used strictly as a parts source, and they can often be picked up for next to nothing. If the set works well, you don't have to be concerned about how pretty it is.

You will also need a tunable converter, covering the 420 MHz band and feeding an unused TV channel in the set. You can homebrew one⁷, or you can pad down the tuning range of a commercial UHF converter. The UHF TV band begins at about 470 MHz and it is a simple procedure to pad most converters so they will cover at least the upper part of the 420 band,^{2, 5} By gentleman's agreement, TV transmissions are usually confined between 436 and 450 MHz, which simplifies things considerably. Most of the simple converters consist of a tunable local oscillator driving a crystal mixer. These units are generally suitable for local work, and you can always add an outboard if or rf amplifier 11, 13 later, if needed.

The transmitting equipment can cover a complete range from the very simple to the very complex. Our basic requirements are a picture generator, a video modulator, and a

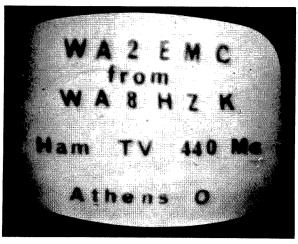


Fig. 2. Signal produced by WA8HZK/8's flying spot scanner transmitter as viewed on the receiver at his shack. The three-tube unit, designed by W2VCG, is capable of transmitting high resolution pictures of photographs and overlays, such as this identification slide.

transmitter. At the simplest end of the scale we have a little three tube rig designed by W2VCG⁴ which will accomplish all of these functions. Using an old TV set as a sync and light source, this little rig will transmit pictures from transparent overlays and 35 mm slides for distances up to several miles, setting the average builder back to the tune of about \$30. A lot of fellows will drop this much on a microphone, so there doesn't seem too much monetary excuse for not giving it a whirl! If you build up more complex pieces of gear, it pays to do it in a modular fashion. This allows you to substitute or experiment at some points in the system without modifying others. This is the approach we used in

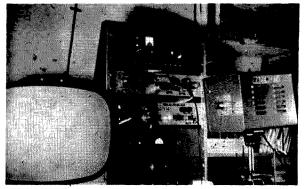


Fig. 3. The portable rig at WA2EMC/8. The TV receiver is on the left with the vidicon camera on the far right. The desk-top rack holds the rest of the video equipment in modular form, consisting (from the bottom up) of the camera power supply, the station power supply, an oral-subcarrier unit, the video modulator, and the transmitter. This is far from being a minimal installation of this type.

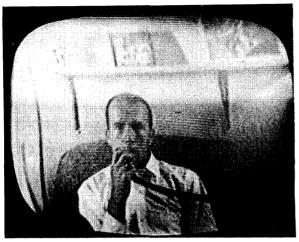


Fig. 4. Signal from WA2EMC/8 as received by WA8HZK/8, about a mile away, showing the author at the mike of the six-meter rig which was used for the audio link. Transmitter output from both stations was about one watt, with dipoles at both ends of the circuit.

building up the gear illustrated in Fig. 3. Picture generators in most amateur stations fall into two general categories, the flying spot scanner (FSS) and the vidicon camera. The FSS, the principle of which is used in the W2VCG rig, is capable of producing high resolution pictures from transparent overlays or photographic slides. An example of this sort of transmission is illustrated in Fig. 2 with WA8HZK's ID slide. WØKYQ⁷ has designed a very versatile FSS unit which is quite easy to build, and will give years of excellent service. FSS units essentially transmit still pictures, while a vidicon camera will give so-called "live" pictures. The FSS is usually easier to build and adjust than a vidicon, and I would recommend that a beginner start with a unit of that type. Even after you graduate to a vidicon, the FSS is still useful for transmitting station ID slides and routine picture material.

When you get to the point where you want a live camera, you have the decision as to whether you should buy or build. There are a large number of small cameras advertised in the catalogs these days, all of which will do a good job in ATV work. If you build, however, it's rather hard to keep from learning something about how the beast works, and I've always liked that idea! If you want to try a kit, there are increasing numbers becoming available. You will find units using either tubes or transistors advertised in magazines such as 73. For the scratch builder, it's hard to beat the five-tube camera designed by WØKYQ8. This unit is built from stand-

ard components, with nothing difficult or hard-to-find. This is the camera I use, and believe me, if I can build it, almost anyone can. ATV Research (see 73 ads) stocks manuals and lots of goodies for this camera.

Modulators

Television is a wide-band mode, and the signal from the picture generator, whether vidicon or FSS, will have a bandwidth of from 2 to 5 MHz. Because of the bandpass required, conventional audio modulator circuits are not applicable. Special, although not complicated, circuits known as video amplifiers and modulators must be used. For strictly local work, it is possible to combine a modulator and low-power transmitter into units with as few as two tubes, ^{3, 12} although other circuits ^{1, 6, 7, 10} can be built in modular form and used with a wide variety of transmitters.

Transmitters

Most fellows start with small single-tube oscillator transmitters. A 12AT7 unit, described by WØKYQ⁷ is typical, and is used in the portable setup shown in **Fig. 3**. This transmitter also produced the picture shown in **Fig. 4**. Most of the higher powered transmitters are crystal controlled. If you already have a transmitter for 420, the chances are that it will be perfectly usable for ATV.

Antennas

Antennas can make or break any station on 420, and even more so in the case of ATV. Virtually any antenna suitable for 420 may be used, just make it the best you can, depending upon individual circumstances.

Audio

The easiest technique here is to use your station facilities for some other amateur band. Six or two meters is quite popular. You can use more sophisticated techniques such as separate 420 fm gear or aural subcarrier units so that the audio will come in on the TV along with the picture, but this is not the best way to start. Usually you have the problem of setting up initial contact on 420, and its best to have a reliable audio link on a lower frequency.

I have included a number of photographs showing what you can reasonably expect to accomplish with a moderate investment of time and effort. The pictures were taken

during one of the many QSOs between WA8HZK and myself during the time we were both studying at Ohio University in Athens, Ohio. Neither of us is professionally interested in electronics, and Ron had had no prior ATV experience when he started work on the W2VCG FSS/transmitter unit which he was using at the time the photos were taken. Ron's TV gear was tucked away in his bedroom at his fraternity house, and I was operating from my rooming house across town. If two average hams, such as ourselves can do it under those conditions, there ought to be many groups all over the country who could do it even more easily. Granted, ATV is now primarily a short range affair, although you can work out as much as 30 miles over flat terrain, using small single tube transmitters. In hills, unless you're on top of them, the range drops fast, and increased power is required. You have to use a band and a mode in order to learn to get the most out of it. The fellows who worked five meters back in the "old days" were supposed to have many of the same limitations, but they dug in and imroved the state of the art-if you don't believe it, look at the VHF bands today. Who wants to do the same sort of experimenting in one of the last frontiers we have in the hobby today?

. . . WA2EMC

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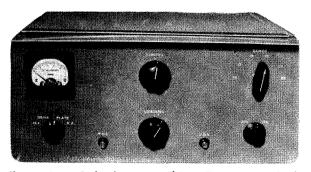
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A Compact Linear Amplifier

A good antenna and a barefoot rig can do a lot for a ham, but sooner or later the bug will get him, and he will want to increase his power. Of course, if you already have a linear or all kinds of cash to go out and buy one, this article is not for you. On the other hand, if you are anything like me—that is, have a bigger junk box than available cash for that linear—and are prepared to roll up your sleeves, you would be surprised with what you can come up with. At least I was.

There isn't anything new under the sun regarding linears and this one really is no different. Many good articles have recently been published and very nicely demonstrate how a linear can be constructed at a low, low cost. Unfortunately, I did not have the 811's or 572B's recommended in these articles; but a pair of 7094's were gathering dust in the shack. Neither did I have three meters as many articles called for, but in the bottom of the junk box I found an O-1 mA meter with a bent needle and a broken glass. As for capacitors, plenty of 100 µF at 450 Vdc were there for me to use and many other bits and pieces left over from the days when a ham was a born "scrounger" and



Front view of the linear amplifier. To maintain high efficiency with the tuning capacitor which was used, two positions are used to cover the 3.5 MHz band—one for 75 meters, the other for 80.

would build his own station from junk.

Circuits and parts

The first thing was to consider the final appearance. For that, I spent the first twenty dollars. An LMB cabinet, Model CO-1, was purchased. This would take care of the appearance, plus match the "S-Line" very nicely. Secondly, after blowing all the dust from the components, I tried to fit all of them into the box in such a way that I would end up with a linear. After a few hours of eager work, I almost gave up. It seemed that I would have to put ten pounds of junk in a brand new, sleek, shiny box that would hardly accommodate a half-pound. Many hours of repositioning the components while burning the midnight oil didn't seem to help. I almost gave it up as a bad deal and put everything back on the shelf, plus a new cabinet, to gather new dust. Finally-eureka! A sub-chassis for the bottles would provide the badly needed room for the components and at the same time would make the linear quite versatile; inasmuch as all hams might not have 7094's like me, this sub-chassis provides sufficient space for almost any other tube lineup. What will happen when my bottles give up the ghost? I can dig all I want in my junk box, but I knew a spare could not be found. Possibly I could come up with another odd pair of tubes. To use them, all I would have to do is remove the sub-chassis and rewire a new one at very little expense. That, I must say, really appealed to me.

The circuit is the sum of all I could dig up on homebrew and commercial linears. Provided there was sufficient space, I tried to incorporate whatever features they had into this design. ALC was considered and finally discarded as impractical and complicated to adjust without proper instrumen-

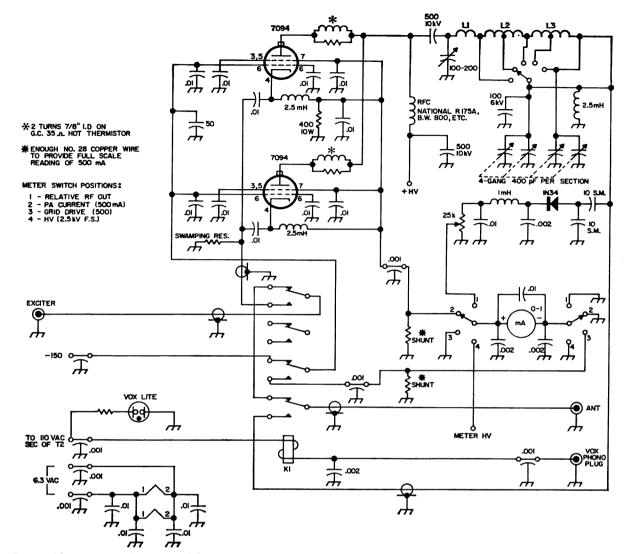


Fig. 1. The compact linear amplifier using two 7094's in the final.

tation. The 7094's are used in the popular grounded-grid configuration. The manufacturer rates these tubes at 400 watts maximum input per tube in grounded-grid. (ICAS maximum absolute rating is 2000 Vdc, 350 mA, or plate input of 400 watts). The beauty of these tubes is that they require only 15 watts of driving power for maximum output. On the other hand, if one has an exciter with a sizeable amount of input power and has very little control over it, it would be wise to consider the installation of a swamping resistor at the input of the linear.

Typical operation calls for 1750 Vdc at 200 mA on each plate, providing 210 watts of usable power into the antenna for each bottle. This meant that my dusty junk-box tubes would be capable of giving me a cool, conservative \(^34\)-gallon dc input without abusing them. Now is the time to start looking



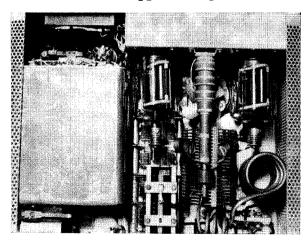
The station at VE2AES. The compactness of the linear in the center can be noted by comparing its size to the transmitter and receiver.

in your own junk box to see what kind of tubes you can come up with. Between this article and those previously published, you should be able to dig out all the answers for your future linear.

The transformer for the power supply was purchased for ten dollars from a surplus house. It is an UTC H-89 with a secondary of 425-0-425 at 320 mA, or 525-0-525 at 300 mA continuous duty. In a voltage doubler I was able to get 1900 or 2250 Vdc under load, respectively. To complete my luck. I came across a "Diode. Inc." high voltage, full wave bridge rectifier pack (500 mA at 5000 Vdc). Unfortunately, one of the legs of the fullwave bridge was shorted. I guess this is what to expect for a dollar. I drilled out one of the connecting pins to which the defective string of diodes was attached. This broke the continuity of the bridge and disconnected the bad string. Best of all, it left me with two legs of good rectifiers that would handle 500 mA at 2500 Vdc. The hole was refilled with epoxy, completing the operation.

The remaining components are pretty well standard. If you do not have them on hand, a quick visit to the surplus store should cure the problem. The total cash outlay for me was around \$48.00, but duplication at full retail price would surely be much higher. Ingenuity and elbow grease are the order of the day if you want to get along with the big guns at a low price.

The output tank was built from a B&W 3905-1 inductor—I used 25 turns, tapped as indicated in the coil table (L3). For L2 ten turns of $\frac{3}{16}$ inch copper tubing were wound



Interior of VE2AES's linear amplifier. The 7094's are mounted on a subchassis mounted on the rear panel of the cabinet. The power supply is mounted on the left-hand side.

into a coil two inches in diameter with about 1/8 inch between turns. Coil LI was wound with 3/8 inch wide copper strap—3½ turns 11/8 inch in diameter.

Before the coils were wound, the copper tubing and strap was polished and silver plated with a powdered plating compound from the Cool-Amp Company*. A word of caution here. Follow the instructions for the plating to the letter. Make sure the parts are cleaned and washed properly, leaving no trace of the plating powder. If you don't, you will find that it will oxidize and you will have to repeat the whole process.

The variable tuning capacitor is from an old BC-375 tuning unit. The capacity is 100 pF. A 150 or 200 pF unit would have been better, but I used what I had. If a 100 pF capacitor is used, the 10 meter portion of L1 will have to be so adjusted to resonate at 29.7 MHz with the capacitor set to minimum. This is the only way that the whole 10 meter band can be tuned. The same applies for the 80 meter band. I used a six-position band selector switch, with separate positions for 75 and 80 meters. Should you be faced with the same problem, it may be wise to make L2/L3 with more turns, trimming them to the exact frequency with a grid-dip meter. The taps on both coils were selected for a Q of 12 or better. The output loading capacitor is a four-gang, 400 pF per section, TRF type I found for \$4.50. You should have no trouble finding a duplicate. If worse comes to worse, a three gang unit should do very nicely.

Another point of interest with this circuit is that you cannot apply drive unless the filaments are lighted. Secondly, if a momentary power failure should occur when the high voltage is applied, a minute will be required to restore the linear to normal operation. Of course, with instant heating filament tubes, this would not be an asset. It is also worth noting that on receive, minus 150 Vdc is applied to the grids of the power amplifier to make certain that there is no idling current. Last but not least, the metering circuit for the high voltage is designed in such a way that it samples at the 300 Vdc level, minimizing potential danger with very little voltage seen at the meter. As for the method of measuring the power amplifier current and drive, it was picked *Cool-Amp Company, 8603 Southwest 17th Avenue, Portland, Oregon 97219.

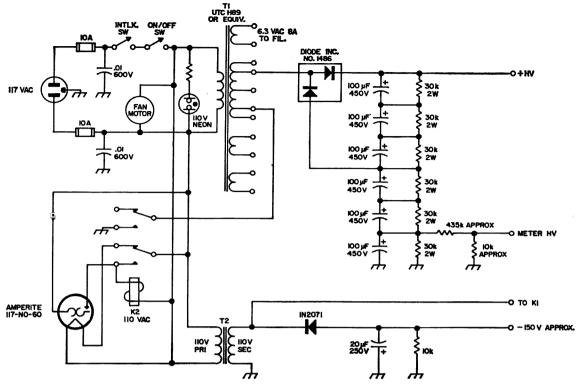


Fig. 2. Power supply for the compact linear amplifier.

up in RCA Ham Tips (Volume 19-3, August, 1959).

In this method, the plate and grid current are measured individually. Although the control grid and screen grid of the 7094's are connected in parallel for rf, the dc return is through their individual meter shunts. This arrangement permits a single milliameter connected in the ground side of the circuit to measure either the plate or the grid current without switching the meter in or out of the high-voltage leads. It also minimizes the possiblity of improper adjustments which could result if the meter were used to measure the total cathode current.

Construction details

Many readers will probably wonder why two RFC's are used in the cathodes of the 7094's. The reason is simple. The ones I happened to have in the junk box would not carry the total current.

Apart from the 2 x 4 x 8 inch sub-chassis, one aluminum plate was bent in such a way that it would accommodate the transformer, which is mounted on the left side, leaving sufficient room underneath for the six capacitors and dividing resistors. The parasitic chokes consist of a strip of copper, .045" thick by % inch wide, formed into a two-turn coil

% inch in diameter that will accommodate a 35 ohm thermistor (hot) mounted inside. These strips are also silver plated as described above.

Tuning procedure

As in any linear amplifier, the meter is used primarily to check the operating conditions. The output indicator helps to achieve maximum output; but for a serious amateur, a monitoring scope with a two-tone generator is really the only way to optimize such an amplifier.

I run the 7094's with a maximum drive current of 160 mA and 400 mA plate current. Plate voltage under these conditions is 1900 Vdc—a little higher than what the manufacturer recommends. The plate current can be reduced to 380 mA to stay within manufacturer's recommendations. The tubes are still holding out very nicely and probably will be for a long time to come. The idling current without the bias is 90 mA. Neutralization was not required.

To those who venture into such a project, I feel assured that, omitting the pleasure of building such a piece of equipment, they will be repaid by at least one "S" unit. At times—not always—this will make the difference between being heard or not.

. . . VE2AES/W6

Cathode Keying Filter

If you are having trouble with key clicks, why not try the time-proven cathode keying filter presented here?

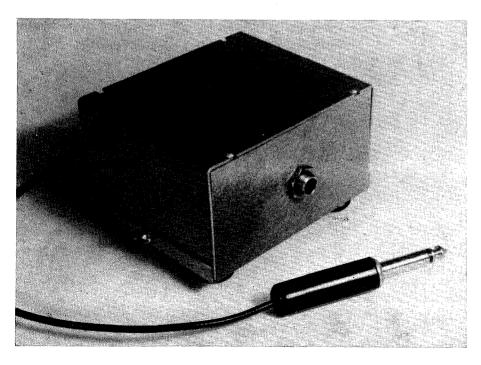
Many gadgets have been described down through the years to solve clicky, thumpy, cathode keying problems. The simplest and most effective circuit is still the old filter choke system described in this article. From the sound of some of the signals on the air today, more fellows should be using a key click filter.

The filter used in this circuit can be built external to the rig in a small California Company box chassis #135, which is 3% x 3 x 2% inches in size. There is no need to go inside the transmitter and make changes which will devalue the price of the rig if it is resold. This system may be more inconvenient than some of the automatic keying systems, where just pressing the key turns the rig on and off, but it is cheaper and foolproof. A double-pole toggle switch can be used with

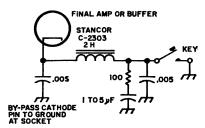
one half turning on the antenna relay and the other half turning on the crystal oscillator or VFO, either by breaking the cathode of the oscillator or the plate supply lead.

For best keying without chirps, the crystal oscillator or VFO should never be keyed, but should be on during the sending period to prevent frequency shift or causing chirps. Leaving the oscillator on during the sending period solves many problems and improves the sound of the signal.

Keying of the final amplifier or buffer by opening and closing the cathode prevents feedthrough from going out on the air, which might happen if blocked-grid keying is used and the amplifier is not blocked off enough. The system is simple, and there is much to recommend cathode keying if the pulse shape is rounded off to prevent clicks by using the simple filter shown in the schematic.



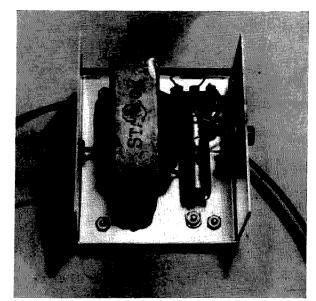
The cathode keying filter is housed in a small chassis box, $3\frac{3}{4} \times 3 \times 2\frac{1}{8}$ inches.



The simple cathode-keying filter.

If you are building a rig and intend to cathode key it, by-pass the cathode to ground at the socket with a .01 disc capacitor. If there is more than one cathode pin lead as in the 6146, use one for keying and by-pass the others with .005 mF disc capacitors. Also, ground pin 8 on 6146 tubes, because that is attached to the skirt which is a metal shield. In most instances the 6146 will not have to be neutralized when pin 8 is grounded. The key lead can be several feet long, but use RG-174/U or RG-58/U to the key. Place a .005 mF capacitor across the key to prevent arcing.

The filter choke used in series with the cathode for the filter should carry the rated current drawn by the tube. For a single 6146, a Stancor type C-2303, 150 mA, 2 H filter choke will work just fine. A 2 to 5 mF (oil filled) capacitor is placed across the key



Inside the cathode keying filter.

in series with a 100-ohm resistor. The 5 mF value will be about the maximum value desired because the signal becomes rather "wing-wing sounding" if it is any larger. The operator can experiment with this value to see what is best for his tone.

Just give this old idea a try and see if it is not much simpler than some of the other circuits now in use.

. . . W6BLZ

Increased Selectivity for the Twoer

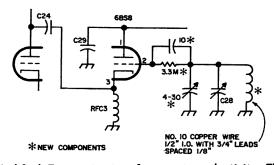
This project was started in the hopes of increasing the selectivity of my Twoer in the simplest possible way. The results are fantastic and the total cash outlay was only two dollars.

In this simple circuit modification, four parts are removed—R10, C26, C27 and L6. A 10 pF capacitor, a 3.3 megohm resistor, a 30 pF trimmer and a new coil are substituted in their place as shown in the schematic. The 30 pF trimmer should be set for complete coverage of the two-meter band with the variable tuning capacitor, C28. You will find that adjustment of this trimmer is fairly tricky. A grid dipper is useful here, but not a necessity if there is plenty of two-meter activity in your area.

After this modification the sensitivity is slightly lower, but this is made up by the amazing selectivity which results from the new detector circuit. If you want more sensi-

tivity, you can add one of the many nuvistor preamplifiers that have been described. Selectivity is estimated to be in the neighborhood of 100 kHz, but will depend upon the strength of the received signal.

. . . Wayne Montague VE3FYL



Modified Twoer circuitry for greater selectivity. The 30 pF trimmer should be set for complete coverage of the two-meter band with C28. A grid-dip meter is useful for this adjustment, but not necessary if there is a lot of I44 MHz activity in your area.

A Simple Resistance Bridge

Every ham that has done any homebrewing, amateur style, has been faced with the problem of calculating resistance. You have just set the bias on that transistor amplifier using a variable pot and now your Scotch soul rebels at leaving it in the circuit when a five-cent composition type would suffice. If only you could get an exact replacement—the circuit calls for two 1,000 ohm resistors, matched to within 1% and all you have is the normal dozen junk-box variety; and on and on!

Many years ago, long before the advent of ham radio, this problem was solved by a man called Wheatstone who designed the Wheatstone resistance bridge. It can be found in nearly every electronics lab where precise measurements are required but is a costly item due to the precision of its parts and the exceedingly high quality of its components. For ham work such very high precision is not necessary and with the current availability of precision multiturn pots and dial counters, a suitable type for our use can readily be made in the workshop.

Fig. 1 shows the schematic of the type I built. With it you can measure, with a high degree of accuracy, resistances from 1 megohm down to 0.01 ohm. This will cover just about any value that the average ham experimenter will want to measure. The equation used for measurement is Ru =

$$R_1$$
 x $\frac{R_a}{R_b}$ and by switching in different

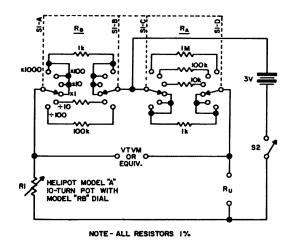
values of precision resistors for R_a and R_b , a large range of values can be measured. R_1 is a 1,000 ohm precision ten-turn potentiometer with a turns-counting dial. Two flashlight batteries are used for the voltage source, and a standard VTVM, adjusted to read centre scale at rest on its lowest voltage scale, is used for the indicating meter. A sensitive galvanometer could also be used.

I used the high-impedance voltmeter described by K3LCU in the July 1966 issue of 73.

Measuring resistance is simple. Plug in the meter and set it to centre scale, attach the unknown resistance to the R_u terminals, turn on switch S-2 and manipulate S-1 and R_1 until the meter balances at centre scale. Read off the value from R_1 and multiply this by the factor given by S-1. For example, if the reading from R_1 is 492 and S-1 is at X1, then Ru would be 492 ohms; if S-1 is at X1000, then Ru would be 49,2000; if S-1 is at X0.01, Ru would be 4.92 ohms, etc.

Layout of parts is not critical, but keep all wiring short and direct, using heavy gauge wire for the arms of the bridge to decrease errors that may crop up when measuring very low values of resistance. Due to the relatively high values of the resistances used for R_a and R_b , contact resistance in switch S-1 will not affect the readings.

. . VE3AHU



Circuit of the simple resistance bridge. SI is a Centralab PA2011 rotary switch, S2 is a SPST slide switch and RI is a precision, ten-turn 1000 ohm potentiometer such as the Helipot model A. The unknown resistance is placed across terminals "RU".

Compact Heat Sinks

Simple but effective heat sinks using standard copper pipe caps.

With the increasing use of solid-state devices as power rectifiers, voltage regulators, and power amplifiers, there is the problem of getting rid of excess heat. If this heat is not conducted away from the junction, internal temperature soon rises to the danger point, and another expensive rectifier, transistor, or Zener diode goes *kaput*.

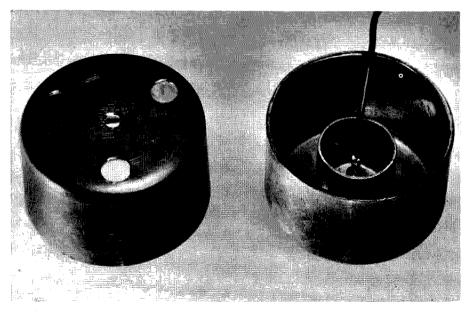
In much experimental equipment, solidstate devices that can have the "hot" (thermally) side grounded are bolted to the chassis, which makes a fairly good heat sink. Insulated mountings of this type are also sometimes possible, by use of mica or other washers which are good conductors of heat, and very poor conductors of electricity.

In much finished equipment, heat sinks are made from sheets of copper, usually ½6" thick, which are stood edgewise, to facilitate convection, and insulated from surroundings as needed. These, if of sufficient area, are most effective, but take up a lot of chassis

space.

Although some "tailor made" heat sinks have appeared on the market, they are usually hard to get outside of large electronic centers such as New York, Chicago, and Los Angeles. A number of experiments and computations show that a cup-shaped heat sink, of suitable material, has excellent heat-dissipating properties. In addition, it takes up relatively little chassis space. A number of them were made up, tested, and found most satisfactory. At about this time, while trying to wangle some more copper sheet at the supplier's, it was found that the copper cups needed for these heat sinks were already made commercially. They are sold as copper pipe caps, and come in a variety of sizes. Shape of a standard copper pipe cap is illustrated in Fig. 1.

Sizes and area factors for these copper pipe caps are shown in **Table 1**. As might be



The copper pipe-cap heat sinks. The unit on the left shows the placement of the vent holes. The unit on the right uses "nested" construction for greater heat dissipation.

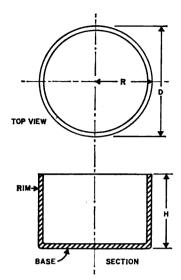


Fig. 1. Standard copper pipe cap. The standard sizes and area factors for these caps is given in Table 1.

expected, the radiating ability of these caps was not a simple function of surface area, and the effective radiating area was considerably increased, in the larger sizes, by suitable venting, which permits convective cooling of the inner surface of the cup. Arrangement of vent holes, and empirical data on their sizes, are shown in Fig. 2. Vent holes smaller than about 1/16" in diameter are almost completely ineffective. Vent holes that are too large are also somewhat ineffective, as they reduce the heat conducting area of the flat portion of the pipe cap. Heat conduction away from the center of the pipe cap tends to be somewhat better than that in a flat plate having the same thickness as the rim of the pipe cap, as the base tends to be considerably thicker than the rim.

Vented pipe-cap sinks cool best when they are mounted above the chassis to allow free circulation of air through the holes. If the heat sink must be mounted close to the chassis, or if absolute maximum cooling is desired, suitable vent holes in the chassis are desirable. These should be at least as large as the holes in the heat sinks—preferably

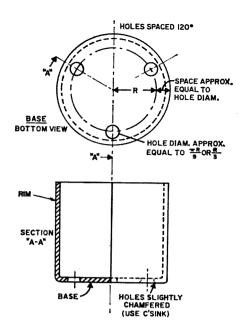


Fig. 2. Arrangement of vent holes in the copper pipe cap heat sinks.

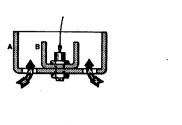
somewhat larger—and lined up with them to permit free air motion. Quite obviously, the chassis should not be hermetically sealed, or air circulation will be impeded.

To permit free conduction of heat from the semiconductor to the sink, the semiconductor must be in intimate contact with it. Good results are usually obtained if the base of the semiconductor fits smoothly and tightly to the heat sink. Use of thermally-conductive "gunk", such as Dow-Corning DC-100 silicon grease, will improve heat conduction somewhat. CAUTION: Do not use a mercury amalgam to improve heat conduction between the semiconductor and the heat sink. This does improve conduction in some instances, but mercury vapor, which is emitted slowly at room temperature, and quite rapidly at higher temperatures, is extremely toxic, and produces irreversible physiological dam-

Possible combinations of pipe caps, to produce heat sinks or large area and small bulk, are numerous, but only a few of them

nominal size inches	h inches	d inches	r inches	outside area square inches	Effective Area square inches	
					unvented	vented
1/2	.6250	.6875	.3437	1.70	2.04	2.05
3/4	.8750	. 9 375	.4687	3.20	4.10	4.23
1	.8750	1.250	.6750	5.13	6.60	7.05
11/2	1.1875	1.750	.8750	8.85	12.40	13.70
2	1.3750	2.250	1.125	12.46	18.70	21.60
21/2	1.500	2.275	1.137	17.00	27.20	32.30

Table 1.



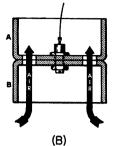


Fig. 3. Combining two copper pipe cap heat sinks to increase the effective heat radiating area. The effective cooling area of the nested arrangement in A at 25° C above ambient is 1.05 [A (vented) + B (unvented)]. The effective cooling area of B at 25° above ambient is 0.95 [A (vented) + B (vented)].

work well. When radiating surfaces are too close together, radiation carooms back and forth between them, and cooling is nowhere as rapid as the areas involved would indicate. Likewise, if the mechanical spacing is too close, convective air circulation is retarded, and cooling, again, is not what you might expect. Two effective combination formats are shown in Fig. 3, with approximations of their cooling properties.

The "nested" format, shown here, is also shown in the photographs. This, in many respects, is the best of the combination formats. The heat sink shown, made from a vented 2" pipe cap, into which is nested an unvented 4" pipe cap, has an effective radiating area approximating 26 square inches,

roughly equivalent to a sheet of $\frac{1}{16}$ " copper 3.56" square, or a circle of $\frac{1}{16}$ " copper 4.1" in diameter.

According to data given by most manufacturers, and verified by tests, this is adequate to cool a 10-watt Zener diode or a 5-ampere rectifier. Because of the greater mass of copper close to the shank of the semiconductor, it furnishes greater protection against the thermal effects of short-term high currents than does a heat sink made of copper sheet.

Although most physics books state (correctly) that a black surface is a most effective radiator, painting these heat sinks black with ordinary paint, such as Krylon, does not improve their radiating properties. Most paints are pretty good thermal insulators, and painting a heat sink black may very well reduce its cooling properties. For most purposes, radiation will be at a maximum if the clean copper surface of these heat sinks is allowed to darken by normal oxidation. A slight increase in radiation can be produced by chemical blackening, or by painting with special radiating paints, such as black "radiator paint."

On the basis of a number of careful, but necessarily crude, tests, it appears that heat sinks made from standard copper pipe caps are a most satisfactory and inexpensive solution to the problem of getting more cooling area in less chassis space.

Simple Test Leads

With each new piece of test equipment, the problem of test leads increases by at least two. This ever-increasing tangle of wires is bad enough, but when you start interconnecting equipment or try to use the leads from one instrument on another, you often hit a snag.

The solution, at first, looked simple: convert all equipment to accept one type of lead. I settled on a banana plug on one end and an alligator clip on the other. This worked for a while, but I soon found I needed a clip on both ends of some and plugs on both ends of others.

After many hours of study, I stumbled onto the fact that the tails of some alligator clips were just the right size to take banana plugs. With this fact in mind, my test leads now have plugs on both ends, and with six or eight clips, I can make the

lead to suit the job.

This procedure has even been carried to test prods. Now, if the situation calls for clipping a voltmeter lead to a wire, it is a simple matter to change the prod to a clip.

The simplest way to convert your test prods is to use a commercial plastic banana jack, file it to fit your prod, attach a wire, and glue the jack in place. Another method is to drill the handle so that you can just force the tubular end of the alligator clip into the prod. Then remove it, break it off, solder a wire on, and drive this into the plastic handle.

This system is well worth the small amount of time and work involved. Give it a try and see if it doesn't help clean up your workbench jungle.

. . . John Foster KØFEG

Robert Brickey W7QAG Electronics Instructor Utah Technical College 349 N. 250 E. Orem, Utah 84057

Evaluating Antenna Feed Systems with Time Domain Reflectometry

Although you are not apt to find a time domain reflectometry system in the average ham shack, it is extremely useful and informative as W7QAG shows here.

Transmission line impedance measurements made with a standing wave bridge, directional coupler, or similar device, yields information on the cumulative effect that the various components in the feed system have on the impedance of the point being measured. Only with a knowledge of the characteristics of all parts of the system can the effects of a particular portion be ascertained. Even with all of this information, which is frequently unobtainable to the necessary precision, the computations are quite involved if the system is very complex.

Time domain reflectometry offers a powerful tool for use in evaluating antenna feed systems, and in some cases characteristics of antennas as well. With this technique it is possible to single out the various elements

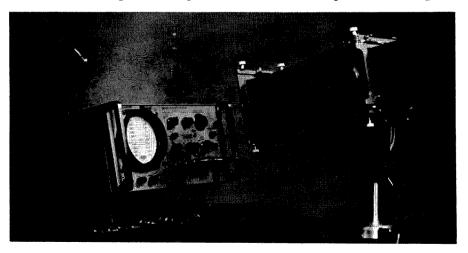


Fig. 1 The Hewlett Packard "time domain reflectometer" installed in the 140A oscilloscope and the "view camera" used in making the scope trace photographs.

of a system and evaluate them individually.

How it works

In operation this system of measurement is somewhat analogous to a simple radar system. A pulse of energy is transmitted through the system being evaluated and the returning echoes give information on the electrical characteristics of any discontinuities in the system. Since echoes from different points return to the measuring equipment at different times, it is possible to isolate and evaluate the individual effects of each component.

The pulse reflection method of locating faults in a transmission system is not new. In fact, it is a proven technique which has been in use for many years for locating troubles in long lines.

Why then all this concern about an old measuring system? With the development of methods for generating pulses of energy with rise times less than one nanosecond, and oscilloscope sampling techniques which provide undistorted observation of these rapid pulses, it is now possible to make a system which has less than one inch resolution as compared with the older systems which could isolate the trouble only to within several yards. Because of the high degree of distance resolution of the new measuring systems, an oscilloscope presentation can be generated which shows an accurate impedance profile of a short radio-frequency transmission system.

The equipment

Hewlett-Packard manufactures a "time domain reflectometer" plug-in unit which is designed to be used with their Model 140series oscilloscopes and it has the necessary characteristics for accurate measurements in high-frequency systems. This equipment, along with the "view camera" used in making the photographs in this article, is shown in Fig. 1. Of course, sophisticated equipment of this type is well beyond the budget of most radio amateurs, and I am certainly not suggesting that all well-equipped stations shouldn't be without one. While it is doubtful, because of the expense, that you will be able to use time domain reflectometry yourself to analyze your own antenna systems, an understanding of the techniques applied should give you a better insight into the behavior of transmission lines in general.

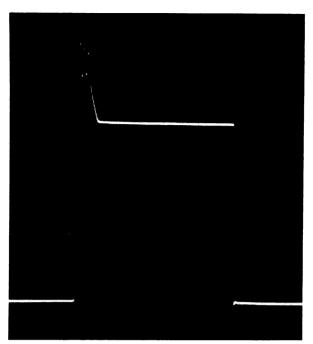


Fig. 2 A photograph of the voltage step output of the "time domain reflectometer" as displayed on a Tektronix type 564 storage scope. The rise time of the pulse is approximately 50 psec.

I have included scope trace photographs of impedance profiles of a number of different feed system components which are widely used by radio amateurs.

The Voltage step

The pulse of energy applied to the transmission system under test by the "time domain reflectometer" is shown in **Fig. 2.** This pulse has a rise time of approximately 50 picoseconds, a repetition rate of about 150 kHz, and an amplitude of approximately .25 volts into a 50-ohm load or

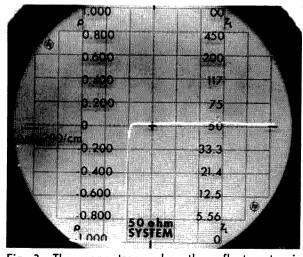


Fig. 3 The scope trace when the reflectometer is connected to a 50 ohm resistive load. As there is no reflection the load appears the same as an infinite length of transmission line.

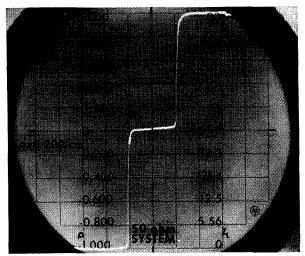


Fig. 4 The impedance profile of a piece of coax cable which has a propagation time of 10 nsec. The far end of the cable was open. The horizontal scale is 10 nsec per division. The voltage step takes 10 nsec to reach the end of the cable and another 10 nsec to return.

.50 volts into an open circuit.

When this pulse reaches the line discontinuity, it is reflected back to the measuring oscilloscope where it is added to the incident pulse. If the discontinuity is resistive and has a value larger than the line impedance, a step of the same polarity is reflected, and if the resistance of the discontinuity is less than the line impedance, a step of the opposite polarity is reflected. Reactive discontinuities also reflect spikes which indicate the polarity of the reactance, inductive or capacitive.

A 50-ohm dummy load

If the output of the time domain reflectometer is connected to a 50-ohm resistive

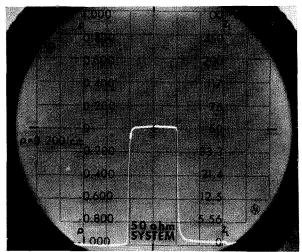


Fig. 5 The same cable with the far end shorted. Notice the trace doesn't quite go to zero on the far end as explained in the text.

termination, it appears as an infinitely long transmission line with no discontinuities to the reflectometer. This is shown in Fig. 3. Note that the impedance scale on the left goes from zero ohms at the bottom of the scope to infinity at the top. On the left the reflection coefficient is given. As you will see in later photographs, this scale can be adjusted so that the discontinuities on the order of fractions of an ohm can be measured

You will also notice that the voltage step is delayed from the time the scope is triggered so that the beginning of the distancemeasurement is visible on the scope screen.

Open and shorted lines

If the input impedance of a transmission line, with the far end mismatched, is measured by means of a standing wave bridge, the measured impedance will depend upon the electrical length of the line as well as its characteristic impedance. If time domain reflectometry is used to make the measurement, this problem is greatly reduced as can be seen in Fig. 4 and 5. The line used in making Fig. 4 had a propogation time of 10 nsec* and was left open at the far end.

The horizontal time scale used is 10 nsec per centimeter of deflection. You can see that 10 nsec was required for the voltage step to propagate to the end of the line and another 10 to return, making the 50 ohm portion of the trace 2 centimeters long. In this manner not only can the impedance characteristics of a line be determined, but also its electrical length. If the physical length of the line is known, this information can be converted into velocity factor.

Fig. 5 shows the same piece of coax cable with the far end shorted. You will notice that the voltage step return time is still the same. Notice, however, that the shorted portion at the far end of the line does not cause the scope trace to register zero ohms. This is because of the attenuation of the cable. The returning echo from the short is not arriving back at the reflectometer with the same intensity with which it left.

This effect can be used to determine the dc attenuation of the cable. It can also result in erroneous impedance profiles if the attenuation is excessive. In most cases, however, the attenuation of short rf lines is low

^{*}nsec = nanosecond = 1×10^{-9} second or one-billionth second.

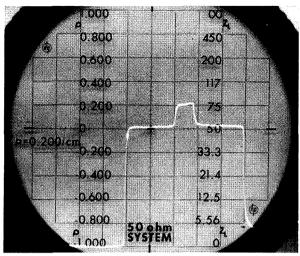


Fig. 6 A 75-ohm coax cable spliced between two 52-ohm cables. The far end was shorted.

enough so it can be neglected when interpreting the impedance profiles. Where the losses are excessive, of course, they must be taken into account when evaluating the profile.

Multi-impedance lines

The impedance profile shown in Fig. 6 was made by splicing a short section of 75-ohm coax in between two 52-ohm lines. The far end of the combination was shorted.

You will notice that the line attenuation has increased—this is indicated by the trace as it starts to straighten out in the lower right-hand corner before reaching the zero impedance line.

This picture shows very well how time domain reflectometry can be used to look selectively at various parts of a feed system and not simply at the total combined effect at the feed point. The electrical lengths of the various sections can be readily determined as well as their impedances.

Transmission line connectors

Next, two sections of RG-8/U coaxial cable were spliced together by means of ordinary UHF male and female connectors. These are the same fittings used on most amateur equipment. You can see the results of this splice in Fig. 7. The fittings appear as a series inductor in the line.

Fig. 8 is the same combination as Fig. 7 except that a UHF 90° elbow connector was inserted between the male and female connectors. It is obvious that impedance bumps such as these could have disastrous effects on a feed system operated in the VHF, or especially, the UHF region.

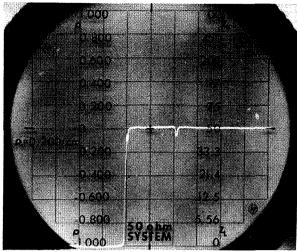


Fig. 7 Two 52 ohm coax cables spliced together with standard UHF coax fittings. The connectors appear as a series inductor.

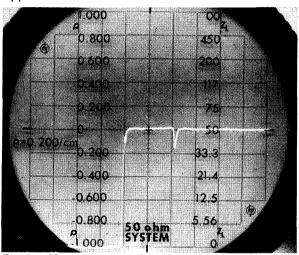


Fig. 8 The same as Fig. 7 only a 90° elbow connector has been added.

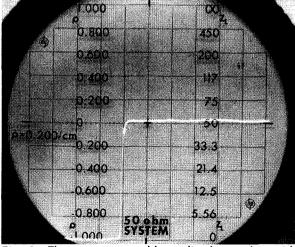


Fig. 9 The same two cables spliced together with General Radio type connectors.

Fig. 9 shows the same two coax cables spliced together with *General Radio* type connectors. The superiority of these con-

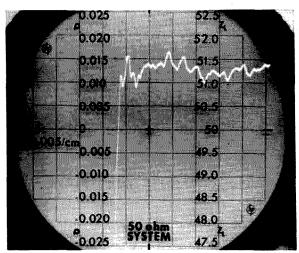


Fig. 10 An expanded view of the impedance variations in a section of coaxial cable.

nectors is obvious.

Increased sensitivity

When the vertical gain of the oscilloscope is changed to increase its sensitivity to impedance variations, some very interesting results are obtained. Fig. 10 is an impedance profile of a piece of RG-58/U coax cable. The sensitivity has been increased to the point where full vertical scope deflection represents only 5 ohms.

As you can see, the impedance of the cable is *not* uniform throughout its length but varies more than ½ an ohm. If the cable is squeezed or bent sharply to distort its inner geometry, it causes an impedance bump that is very evident. Usually when a cable has been compressed or bent in this fashion, the impedance bump remains even after the pressure is relieved, since

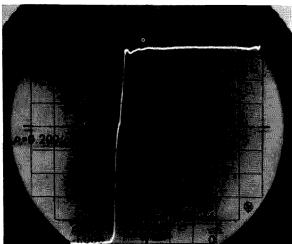


Fig. 12 The impedance profile of a section of 300 ohm twin lead spaced several inches away from metal objects. The slight impedance "bump" at the beginning of the line is explained in the text.

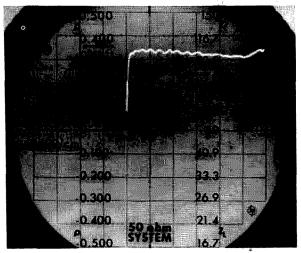


Fig. 11 A scope trace showing the impedance variations in a piece of ordinary "zip cord".

the cable dimensions do not quite return to normal.

Variations in cable impedance of about ½ ohm can be produced by simply waving the cable back and forth slightly between two end supports. While variations of this magnitude are not usually significant, at least in amateur applications, it is very interesting to observe them on the scope.

Fig. 11 was made by connecting a random length of ordinary 120 Vac "zip cord" to the output terminals. The vertical sensitivity has been reduced, but impedance variations, probably caused by irregular spacing of the conductors, is still quite apparent.

What? Your feed line goes down the mast!

The last set of photos was included primarily to show the detrimental effects of improperly installed twin-lead feed lines.

For the purpose of the demonstration, I used a section of ordinary 300-ohm television feed line. Fig. 12 shows the profile obtained when the line was connected to the output terminals and suspended several inches away from any metallic objects. You will notice a slight impedance bump at the beginning of the line caused by the balanced feed line being connected to the unbalanced coaxial output of the time domain reflectometer. Otherwise, the trace shows a uniform impedance characteristic near 300 ohms.

Fig. 13 shows what happened when the I grasped the line with my hand near the far end. In the affected section the impedance dropped to almost half of its normal value.

The line was then threaded through a short piece of 1" water pipe. This simulates

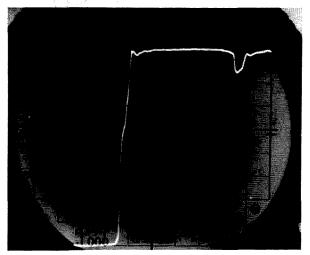


Fig. 13 Impedance "bump" caused by grasping the 300 ohm twin lead with the hand.

the effect caused by running an antenna feed line down through the center of an antenna supporting mast. The impedance in this section was below 200 ohms, and incidentally, varied considerably as the line was moved around within the pipe. See Fig. 14.

What if you put the feed line on the outside of the mast rather than running it down inside? In Fig. 15 the line was taped to the outside of a piece of 1" pipe every few inches. Enough said about that.

When a feed line is a little longer than necessary, it is always tempting to just coil up the surplus rather than cut the line. Fig. 16 was made by wrapping the line into a neat coil about 6" in diameter. At one point this caused the line impedance to go almost to infinity. It would obviously be much better to cut the line to the proper length and splice it in the future if necessary.

Summary

There are a great number of other applications for the time domain reflectometer. It is very useful for such things as adjusting the lengths of phasing sections in multi-element antennas, checking the characteristics of broad-band impedance matching devices, measuring the impedance characteristics of wide band antenna systems, etc.

I hope that the examples I have presented will serve to increase your interest in this valuable measuring technique and also help you to appreciate some of the things which happen in amateur radio antenna feed systems.

... W7QAG

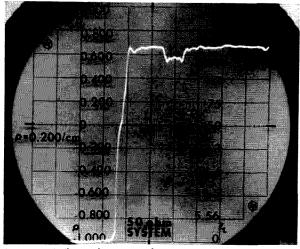


Fig 14 When the 300 ohm twin lead was passed through a 1" water pipe it's impedance dropped sharply to less than 200 ohms.

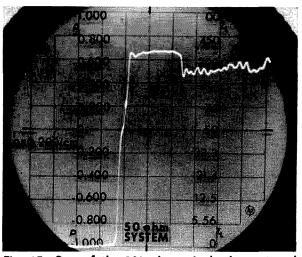


Fig. 15 Part of the 300 ohm twin lead was taped to a 1" pipe every few inches. The impedance of the taped section varied considerably and was less than 200 ohms.

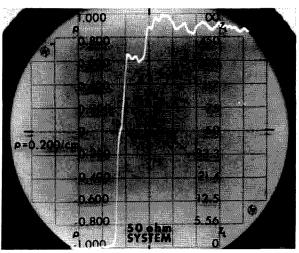


Fig. 16 Impedance changes caused by coiling 300 ohm twin lead into a neat 6" diameter coil. Notice that at one point the impedance is almost infinite.

Cheapskate's "On The Air" Sign

Novices, attention! Are you troubled by all sorts of in-shack QRM? Do you miss that other guy's call because your wife is yelling her head off trying to get you to take her shopping? Well, this is the one article that might be able to relieve the above disturbances.

The On-The-Air sign I'm about to describe is about the cheapest one around. It shouldn't cost you more than, oh, say, six bits at the most and can be assembled in close to two hours. The materials used can probably be found around the house.

First get a small cigar box the size, approximately, of a 3" x 5" index file. I had one that held imported cigars. Next, get a piece of glass that will fit snugly into the opening of the box. While you're getting the glass cut, pick up a small ceramic bulb socket and a couple of feet of appliance cord.

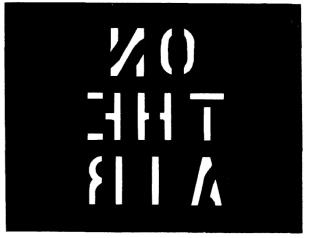
Now, get hold of some stencils about 3/4" long. Lay out three guide lines on the glass so each word, on, the, and air are on sepa-

rate lines. Place the stencils on the glass backwards and reverse order because you will be painting the glass from the back. See Fig. 1.

When you have all the letters stencilled out, get some red enamel paint. Paint around the letters, not in them. The light will shine through the words and not the background. See Fig. 1.

While you are waiting for the paint to dry, take the socket and fasten it with epoxy cement to the side of the cigar box. Set the box on end to let it dry overnight. When the cement dries, drill a 1/4" hole in the bottom center of the box to pass the cord through.

Take a small wattage bulb, about ten watts, and screw it into the socket. Take the glass and check the fit in the end of the box. If it fits ok, place a little bit of epoxy cement around the outer edge of the glass



LETTERS MUST BE REVERSE -STENCILLED. PAINT AROUND LETTERS WITH RED PAINT.

BACK OF GLASS SHOWN

and gently place it into position in the box. This step can be facilitated by placing the glass face down on a clean flat surface and lowering the box onto it from overhead. When the cement dries for a day or two you can finish the box in any color to match your rig.

Now to hook it up to the rig. I have an accessory socket on my T-60, so all I had to do is connect the wire ends to the 117 volt pins on the accessory socket. The sign lights up whenever I turn the rig to AM or CW. If you don't have an accessory socket on your rig, wire a SPST switch in series with one of the leads and mount it somewhere inside the box before you position the glass. Then tap into your power line.

One more thing. When I first used the sign, I was able to see the inside of the box through the stencilled letters. I got a 3" x 5" index card, trimmed it to fit the glass plate, and placed it on top of the paint before it dried. When the paint did dry the card stayed in place. Try the box with the light on before you stick on the glass and see if you have need for an index card.

With the On-The-Air sign glaring at your "QRM", she will get the message and pipe down until you QRT, or the other guy's wife makes him take her to the store. But before you sign off with the latter, tell him about this sign. Maybe he could use one for his disturbances.

. . . WN3EWV

Mobile Installation Without Drilling

With the present trend toward mobile installations, car dealers have a good excuse to lower the trade-in value of your car if it is full of holes because of a mobile installation. Also, the little woman may be a lot happier if she knows you are not drilling a lot of holes in the new car.

Let's start with the antenna, which can be mounted with any good bumper mount, or one of the new deck mounts that requires no holes. Be sure to follow instructions. This is not the ultimate in antenna installations, but no holes are required. The feed line can be routed through the trunk. The gasket around the trunk lid will usually give enough to allow it to close on the cable without damage. Then route the cable under the back seat, under the carpet and on to the front. Be sure to keep the cable away from sharp edges on moulding, seats, and other hardware.

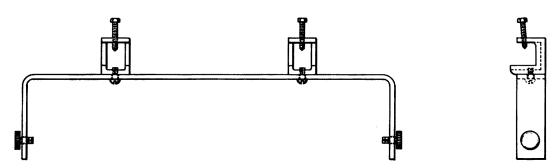
Next comes the transceiver. Obtain two small electrician's beam clamps and fasten them to the transceiver's gimbel bracket as

shown in Fig. 1. Position the bracket under the dash in the desired position, and tighten the set screws. If the set has a selfcontained power supply, speaker, etc., you are almost in business, as power can be obtained from the ignition switch. However, if your rig has a separate power supply, locate a rubber feedthrough grommet (on the firewall or under the carpet) and feed the power cable into the engine compartment. Carefully select a place for the power supply, so that it will not be exposed to extreme heat. In addition, you may be able to use existing holes to mount it. As a last resort, holes can be drilled to mount the supply-car salesmen seldom look under the hood for holes!

Bonding of hood, tail pipe, and all ignition suppression should be taken care of at this time. The rest of the installation is handled in the normal manner. When the time comes to trade the old buggy off, not a sign of mobile installation.

Happy mobiling.

. . . Forrest Thomas K9MRL



No-holes mobile mount using electrician's beam clamps attached to the transceiver gimbel mount.

Relay Energization In Fixed And Mobile Equipment

The antenna and power switching circuits in fixed/mobile transmitters and transceivers should meet several requirements. First of all, for safer mobile operation and for convenience when fixed, they should be activated by a single control. If the switching system is electronic or electro-mechanical in nature, it should be foolproof, consume a minimum of electrical power and be such that it may be activated by either the dc or ac power supply.

Most amateur equipment employs a relay as the switching device, the relay being operated indirectly by voice or manually by a switch. The former is known as the VOX system, the latter as the PTT (push-to-talk) system. When building a six meter transceiver recently, I decided on a push-to-talk system, feeling that it would best meet the criteria discussed above. I was surprised at the number of methods used to energize the relay, some of them not too popular in amateur designs but yet ideally suited for fixed/mobile equipment. A review of some of these methods is worthwhile. The last, and incidentally the simplest, method was used in my transceiver with a novel system to reduce power consumption.

Energization from filament supply voltage

A typical relay switching system of this type is illustrated in Fig. 1. Notice that this hookup is suitable only for a negative ground system. If battery polarity were reversed, the diode would require reversing, and the positive terminal of the electrolytic would be placed at ground potential. In fixed operation the half-wave rectifier recti-

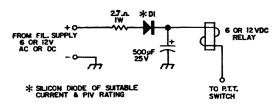


Fig. 1. Relay energization from a 6 or 12 volt filament supply.

fies the usual ac filament voltage. Considerable filtering is usually necessary to prevent relay chatter.

Insertion in the cathode circuit of modulator or rf stage

As shown in Fig. 2, the relay is energized by the static plate current of the modulator stage. The relay resistance should approximate the proper cathode resistance value. This hookup is especially suited for the use of surplus low-resistance dc relays.

Energization in the plate circuit of a low power transmitter stage

Fig. 3 is useful for dc relays in the 1000

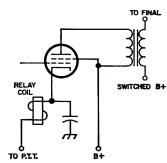


Fig. 2. Controlling a relay by mounting it in the cathode circuit of a single-ended modulator stage.

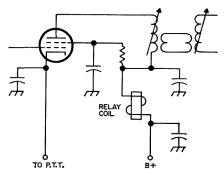


Fig. 3. Picking up and controlling a relay by wiring it into the plate circuit of a low-powered transmitter.

to 6000 ohm range. Although the relay will function as a plate-dropping or isolation resistor, the design should ensure that the relay coil does not overheat from excessive current flow through it.

Energization from the dc plate supply

Fig. 4A illustrates a conventional circuit with the relay coil and associated dropping resistor in series with the PTT switch. The arrangement of Fig. 4B shows a method for reducing the power consumed by the relay. It is based on the fact that the holdin current for most relays is much less than the current for pulling in the armature.

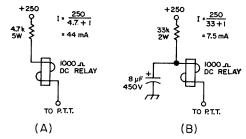


Fig. 4. Using the high-voltage dc plate supply to control a relay.

When the PTT switch is open, the capacitor charges to the value of the high voltage. Should the PTT switch be closed, partial discharge of the capacitor creates enough additional current to cause the relay to pull in. After this initial surge, the current drops to a value just sufficient to hold in the relay. For comparison purposes, the resistance value in each case was increased to a point where the relay would just snap in and hold. The reduction in current would certainly be a consideration in many cases.

I hope some of these ideas can be incorporated into that new piece of gear you are planning or that old mobile transmitter with all those switches.

. . . Murray Ronald VE4RE

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How to be a Ham—By Really Trying

This is a ham article designed for those of you who are *not* hams. How's that you say? Well, it's designed to talk you into becoming a ham. But you'll say, "There have been lots of articles designed to do that."

This one is different because it was written by an expert in procrastination, a ham who took ten years to become a ham. A ham who knows, or thinks he knows, why you don't become one. The reason is simple and direct. You are lazy! That's right, lazy. There is no other word for it.

"The code is too hard." "The theory is too tough." My ears ache when exposed to Morse." I know the excuses—I've used them all. The trouble is, they all decipher down to, "I'm too lazy!"

I'll give you a little credit. I don't really mean mental laziness, the kind that means you cannot be bothered learning, or even moving over to the book rack to pick up a theory book. I mean the subconscious, confidence-robbing laziness that you don't even know you have. This well-hidden mental monster is the worst kind. Not only is your ambition handicapped, worst of all, your will to even start is limited.

Here is a real monster, far more serious than other handicaps—fingers that can't possibly write "Morse" and ears that have 57 dB attenuation to the code. What's worse, you don't even know it's there, but it is, working continually, keeping you from becoming a ham.

Whether we know it or not, we all suffer from self-defeatism. We are beaten before we start. The man who said, "A journey of a thousand miles begins with a single step," really knew what he was talking about. The biggest part of any job is the *start*. Start something and you have about an 80% chance of finishing it. If you don't start at all, you don't have a chance.

Starting a project of any significance can be compared to the laws of motion and energy. To start an automobile moving requires about nine times the energy required to keep it moving at a constant speed. The hardest part by far is the start. We are constantly being defeated in our ambitions by this simple fact. Our projects are defeated before they get started because they are never begun.

I was "all hot" to become a ham at the tender age of fourteen. However, even at this age the passive procrastinator was already well formed. As everything else came hard for me, I reasoned that becoming a ham would be no easier.

I could not possibly master the Morse code. You have to be some kind of mental marvel to do that, like my friend up the street, Cristofer Codepopper. Or my long-time buddy, Moris Muddle, who was known as the ten-word whiz because he got his ten words so fast. These were real men. I knew they were exceptional because they had learned the code. Obviously I wasn't as smart as they. How could I compete with that attitude?

That is how I went, for years and years. "Are you a ham? Boy—it must be something to know Morse; I wish I could learn." During all this time I tried all the tricks I knew to become a ham. I tried to get the rules changed, thought about pirating, and the like. I did everything but one thing—try. Oh, I came close once, I became very determined and tried to listen to Morse on the air. I even set a deadline—I would learn code in three months or know the reason why.

However, I soon reasoned that I was one of those poor unfortunate people who just didn't have the aptitude for code. I was un-codable. The mental monster, procrastination, had won the first round.

Finally, as misery is a lonely old soul and likes company, I met others who also could not master Morse. We formed a club—the un-codables.

Funny thing about a club, it builds incentive even though you know you are only as stupid as the next fellow. You know darn well that you cannot master Morse any better than he can, but somehow you must have something more on the ball than this guy. If you could possibly learn the code, it would sure make him look ridiculous, wouldn't it? Likewise, if he got his Morse first it would sure make me look stupid.

For the first time you begin to think dangerously. You think, "Maybe I could learn this Morse code." You begin doing very strange things like sitting down and really applying yourself. You listen to W1AW every night without fail. You attend regular code practice at the club. You honestly try to copy code on the air. A more realistic time limit is set. There is no hurry. Ham radio is on the move, but it is not going anyplace. Figure on a year. The only important thing is regular practice and study. This means regular. Even ten minutes a day, but every day.

Most important—decide that you can do it and that you are going to do it. Make that first important move—start! You can do it. How do I know? Well, I did it and I am no genius. All I have ever done is learn Morse—and anyone can do that.

. . . VE3GLX

Poor Mans Antenna Switch

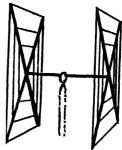
When several antennas are to be used on one transmitter, it becomes quite a task screwing and unscrewing PL-259 fittings. After a while the threads give up, so pliers and cuss words are in order.

Solution: Take a sleeve from an old PL-259, saw off the back end about 1/16 inch to remove the small ring that keeps it from pulling off the fitting. Bevel the inside corner slightly with a knife. Saw four slots from the back down to the threads. Flatten the thread end very lightly so it will be a snug fit when screwed on the chassis fitting. Screw the modified sleeve on the deck fitting, unscrew the sleeves from the coax lines, push back and tape to the lines for future use. Your antenna can now be changed with the same ease that is used in plugging in a set of headphones.

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Do—It—Yourself Mobile Mount

Having decided to try mobiling for a change, I purchased a used transceiver with power supplies but with no mobile mount. Looking into possible kits for installing this equipment, led to the conclusion that one could be fabricated quite easily from material on hand.

A piece of ½ inch plywood 10½ x 17 inches was selected for the base to carry the transceiver. The corners were rounded

at one end, and at the other end I tapered each side as indicated in the drawing. The small end was then contoured to fit over the drive shaft tunnel in the middle of the floor. A small metal bracket was then attached to the center of this contour so the base could be secured to the floor with a metal screw.

Holes about % inch larger than the feet of the transceiver were bored at each corner

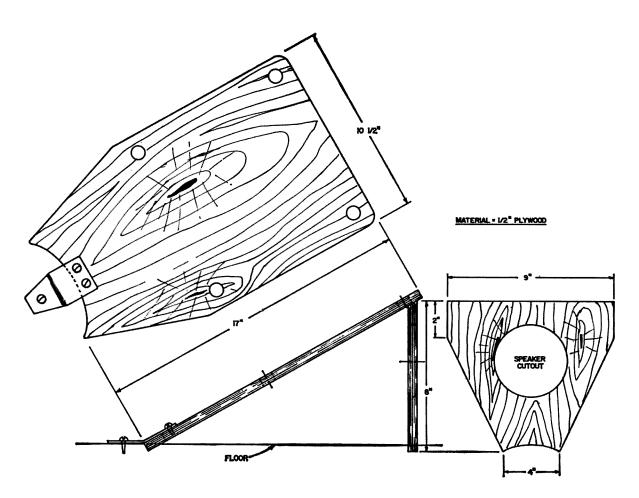


Fig. 1. Do-it-yourself mobile mount constructed from one-half inch plywood. The transceiver is force-fit into the four feet-mounting holes drilled in the top board. The speaker is mounted on the front. The bottom of the mount is contoured to fit over the drive-shaft tunnel in your car.

of the base to accept the feet. The edges of the holes were thoroughly sanded. Four discs of ½ inch felt approximately 2 inches in diameter were cut out. These felt discs were placed under the feet of the transceiver and pressed down with the set to form a secure socket, resilient and secure.

The base with the mounted transceiver was then placed in the car and temporarily propped up to the desired operating position. A template of cardboard was made for the bracket to support the front of the base and speaker, as shown in Fig. 1. A flange was turned over at the top to the

proper angle and fastened to the front of the base. A four-inch hole in the upper portion of this bracket accommodates a speaker.

After all was assembled, the base was thoroughly sanded and the edges slightly rounded. The completed mounting base and transceiver case was then sprayed antique gold to match the car interior—this was a wife pleaser! Although this exact design may not be duplicated exactly because of different transceivers and cars, this unit has proved very satisfactory for me.

. . . W6APE

Tuning RTTY Shifts With a Piano

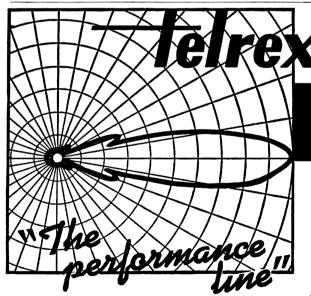
Obtaining reference frequencies for setting up mark and space shifts on RTTY equipment can be quite a problem, but if a piano, which is in relatively good state of tune, is available, it will provide a close reference.

The easiest method is to tune in your FSK VFO on the receiver and zero beat the note with "mark" condition. Count up to the fifth "G sharp" from the bottom of the piano keyboard. This note is very close to 850 Hz and by adjusting the shift on "space" to match the note (leaving the receiver untouched) the desired 850 Hz shift will be obtained.

If overload or "pulling" makes it difficult to obtain a good zero beat on your receiver, an alternate method may be used: the highest C sharp is approximately 2125 Hz, and the highest F sharp is approximately 2975 Hz. If the mark and space are matched to them when monitored on the receiver, you will arrive close to the correct shift. In this case, adjust the receiver to match frequency to the lower note on "mark" condition, and then, without shifting any receiver adjustments, match the "space" tone to the higher note.

This might be used in conjunction with an electric organ, but only if the keyboard has the standard 88 keys. Otherwise you could wind up with the wrong notes. The piano method is sure fire . . . except in extreme cases of "tin-ear".

. . . Tom Park W6SYX



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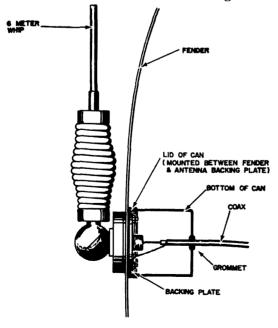
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Wash Out Your (Antenna) Shorts

Last spring I purchased a four-wheel-drive truck and since it didn't have a broadcast radio in it I installed one. Due to the shape of the front fender the antenna had to be mounted on the side of the vertical section. There was another panel on the inner side of the fender so the antenna had to be mounted below this inner panel and because of this the coax cable plug was exposed to the weather inside the wheel well. A short time later I mounted a six meter whip on the opposite front fender, but this time I used a regular mobile mount complete with spring and backing plate. Both antenna plugs were sprayed with TV high voltage dope, in the hopes it would waterproof them, but the back side of the plugs couldn't be reached with the spray.

Spring turned into summer, summer into fall and all was ok except at times there was some noise in both receivers during a rain



storm, but it was blamed on rain static and outside interferrence. Finally fall turned to winter and then the noise really started, especially during and after a snow storm. Also it was noticed that the six meter transmitter was acting up and "not getting out". I was beginning to think it wasn't outside noise at all, but right in the truck. So I started checking and found that both antenna coax cables, after a rain or snow, had between 400 and 1500 ohms resistance when measured at the receiving end. Evidently the front wheels were throwing rain or slush up under the fenders where it would collect on the antenna plugs. Of course during snows the good city fathers would order the salting trucks out, and the salt with the snow really did a good job of shorting.

It was decided that these plugs would have to be made more weather proof, and the best way should be some kind of a metal housing. Well, the solution was simple but I had to wash my hands a couple of times before I found it. I needed a can with a screw on lid, and there on the sink counter was such a can-waterless hand cleaner. The can was about four inches in diameter and three inches high. After a hurried trip to the store for another can and dumping the contents of both cans into an empty peanut butter jar, I cleaned the outside of the lids with sandpaper. I thought this might be better for grounding, if it was necessary. The paint was left on the sides of the can for protection, and besides, who was going to look up your fender anyway.

I removed both antennas and cut a hole in the lid of one can, just large enough to pass the BC whip's single feed through insulator. On the lid of the other can I centered the backing plate of the six meter whip and cut out the large center hole and the bolt holes. In the bottom of each can a hole was drilled to hold a grommet that would fit snugly around the coax.

The six meter antenna was remounted with the backing plate on the inside of the can lid and the can was screwed up tight to the lid. Now to the BC antenna-here I ran into a wee bit of trouble, the antenna was sloppy after tightening up the mount. The lid of the can was acting as an "anti-friction washer" and would allow the antenna mount to swivel slightly. The can lid needed more friction between it and the fender wall. A hammer and nail solved the problem. The lid was laid on a board with the outside of it next to the board, then the nail was used to puncture a lot of small holes in the lid. When the antenna was remounted the burrs from nail holes dug through the undercoat and into the metal of the fender and held the antenna solid. The burrs also provided good grounding for the outside shield of the coax.

A friend who had a whip mounted on the rear fender of his car complained that several times he had broken the center lead of the coax when loading or unloading the trunk. I showed him my brain child and told him it would solve his problem as well as it solved mine. Later I heard he stopped at the store, on his way home, for a can of hand cleaner; but I never did find out if he had an empty peanut butter jar.

. . . W3RZD

Antenna Coil Protection

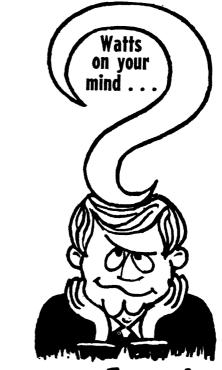
In order to prevent the antenna rf coil in your receiver from burning out when a transmit-receive relay fails, solder a grain of wheat neon bulb (#NE-2) between the antenna connection and ground (chassis) of the receiver. If rf hits the receiver, the path is to ground, not to the antenna coil. Insurance is cheap . . . antenna coils are expensive.

. . . Jack Weatherly K1ZYG

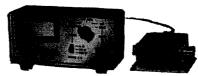
Sharpening Chassis Punches

Lacking a grinding wheel, a round chassis punch can be sharpened equally well on an oilstone. Use the first and second fingers to grasp the "flats" on the back of the punch, applying pressure with the thumb on the forward stock. It is best to count the strokes so as to equally sharpen each side of the punch.

. . . Ray Ezelle WPE8JJQ



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beverly airport beverly, mass.

A Polarity Sensitive Meter for the Sightless

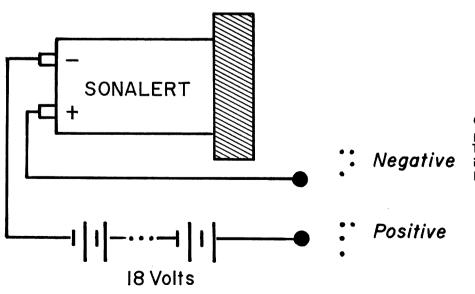
Here is a simple polarity-sensitive meter which may be used for checking diodes, capacitors, and within a limited range, resistors. It may also be used for testing continuity or as a code practice oscillator.

This article describes an easily constructed meter for checking capacitors, rectifiers, resistors, and general continuity testing. The device consists of a Mallory Sonalert oscillator connected in series with two miniature 9-volt batteries. The Sonalert and batteries are mounted in a plastic box, 6 x 3¾ x 2 inches. The output terminals are marked in Braille to allow easy polarity identifications.

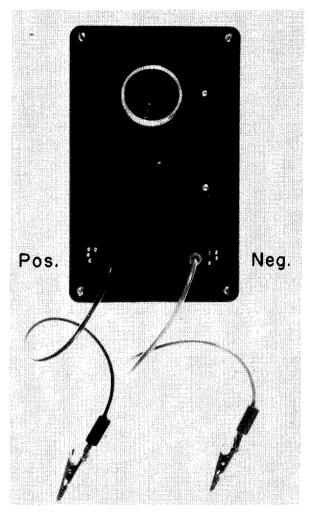
The procedure in testing a rectifier is as follows: connecting the tester leads to the rectifier will indicate the anode and cathode by listing for the audio tone. If the tone is

heard, the positive lead of the tester is connected to the anode and the negative lead to the cathode. Turning the test leads around will produce no signal. If the signal is heard in both directions the rectifier is shorted; if no signal is heard in either direction the rectifier is open.

It is possible to tell the approximate capacitance of a capacitor by noting the length of the audio signal that is heard as the capacitor charges. The larger the capacitor, the longer it takes for the capacitance to



Circuit diagram of the polarity-sensitive meter. The entire unit is housed in a small plastic meter box.



This audio polarity-sensitive meter uses a Mallory Sonalert module and may be used for checking rectifiers, capacitors and resistors. The output terminals are marked in Braille.

charge. This device is good for capacitors down to 0.01 mF. Electrolytic capacitor polarity can be obtained in the following manner: if the positive side of the capacitor is connected to the positive lead of the tester, and the negative capacitor lead to the negative side of the tester, the capacitor will charge and a brief tone will be heard. If the leads are reversed the tone will be continuous indicating wrong polarity.

The approximate value of a resistor can be obtained with this method; the greater the resistance the weaker the audio tone. Resistors above 20k ohms will give no audio tone and cannot be checked.

This unit can also be used as a code practice oscillator, or the Sonalert can be used by itself as a grid bias alarm. This versatile gadget has many potential uses for the sightless as well as sighted radio amateur.

. . . WA2BCX



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SPECIFICATIONS:

- ullet Measures 23/4" imes 4" imes 7" (excluding lens and connectors).
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- Operates on 100-130 volts 50 or 60 cycles, 7 watts.
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Climbing the Novice Ladder: Part X

FN offers Joe and Judy sage advice.

On the appointed Saturday, Judy and Joe trekked out to FN's place, reluctantly leaving their own cozy shacks where the neverending thrill of contacting other stations was most exciting. Judy reported seven states already QSO'd for her eventual WAS award; most of these had been relatively local in the 80 meter band. As her confidence had



"Judy works on the WAS award . . . "

mounted though, she had ventured into the 40 meter group having first picked up a suitable crystal for this band. Two locals had answered her first CQ's here but the thrill came when she had called a California station, conversed with him for half an hour and added him to her WAS list. Ioe too, had not been idle; he had finished his T-60 kit, Larry had checked his work and Joe had then taken the rig to FN for inspection before putting it on the air. With a couple of suggestions for minor wiring re-routing, FN pronounced it a satisfactory job, plugged it in and gave it an on-the-air test. It loaded nicely and FN's field strength meter indicated that for a 60-watt rig it was putting a pretty fair wallop into the air.

After a few minutes of small talk FN said, "Well, suppose we get at the meat of this meeting; we were going to talk about clubs, magazines and operating procedures, remember? I know you're both itching to get back to your shacks and pound the key, but there are other considerations in ham radio that you should know and that's what we're going to talk about today . . . let's start with clubs.

"Both of you already belong to your local club; that's as it should be. Be as active as you can and participate in as many of their activities such as field day, national and local contests and the like, as often as you can. Attend as many meetings as you can manage and keep your ears open for what the usually excellent speakers have to say . . . learn as you go in other words. You will have the local club situation well in hand then and can begin to consider what you want to do about clubs and organizations of wider scope.

74 73 MAGAZINE

Of all such groups open to all types of hams and would-be hams all over the world, the American Radio Relay League, familiarly referred to as the ARRL, is the oldest and best known. The word 'relay' in their name, while kind of a misnomer these days, dates back to their founding in 1914 when the spark hams of that time generally had to reach distant stations with messages by 'relaying' through one or more other hams. 'DX' as we know it now, was then unheard of . . . several hundred miles at best was the average transmitting range of the most powerful of the early ham stations, although a number of greater distance records were occasionally hung up, but they were the exception rather than the rule. Something like about one third of the approximately 300,000 hams in the world today, belong to the League. Taken all in all, it's a good organization, although they are, like any other group of their magnitude, subject to criticism, some of which is deserved. Personally, I don't accept all of their policies, lock, stock and barrel and I am not alone in this, but that doesn't prevent us from maintaining membership. So much then for the ARRL; let's look at a few other groups.

Probably one of the first and best for you to affiliate with is the QRP AMATEUR RADIO CLUB—International. This is a group of some 3000 amateurs scattered throughout the world who are dedicated to low power operation as their contribution toward relieving the tremendous amount of QRM now existing on all bands. With your power restriction of 75 watts as novices, the ORP club is practically tailored to fit. And, as a very large majority of novices are in the juvenile age groups which ordinarily makes economics very much a factor, life membership in this organization costs only two dollars which imposes no hardship on teen-age budgets. They also publish a quarterly News Letter which contains a lot of meat on their activities, contests and much more; you receive the first years' issue of this paper free when you join; a dollar a year after that if you want to continue it.

There are a number of other clubs and organizations for the ham, although the doors of some are automatically closed to you at this time. You could hardly be considered for membership in the QUARTER CENTURY WIRELESS ASSOCIATION for example where a background of 25 years as a licensed amateur is a requisite to member-

ship. Even less open to you are the portals of the OLD, OLD TIMERS' CLUB where, instead of 25 years, 40 or more years of licensed hamming must be proven to make you eligible to this elite group.

"Suppose now that we take up the matter of magazines; you are going to want to keep up on ham affairs in general and the very best way to do it is to read the monthly periodicals devoted to the ham. Of these there are three which treat with amateur radio exclusively. One of these, OST, published by the American Radio Relay League, you can have only by becoming a member of the League. Copies are not available on the newsstands nor can you subscribe without becoming a League member. The other two, 73 and CO are both available in single monthly copies at most electronic stores catering to the ham. All three stores in town here for example, carry both of them. You'll make a substantial saving and always be assured of receiving your copies regularly if you subscribe by the year to either or both . . . your economic status will have to determine that.

"The three I've mentioned are, as I've said, devoted exclusively to ham radio. There are a number of other publications which often carry a number of first-class articles for the radio ham and to which you should give



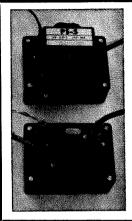
"FN discusses the matter of ham publications."

more than a passing thought. Two that come to mind right at the moment are RADIO-TV **ELEMENTARY EXPERIMENTER** a n d ELECTRONICS. While the contents are not confined to the ham reader alone, there is a great deal of electronic information of general nature which is of considerable value to the radio amateur; constructional articles cover both ham radio gear and related electronics equipment such as hi-fi, sound recorders, record players and such miscellane-ELECTRONICS products. ILLUSous TRATED and POPULAR ELECTRONICS are another pair with similar content. Then there is RADIO ELECTRONICS and ELEC-TRONICS WORLD. The former is directed more toward the radio/TV service technician although it often includes a number of hints and tips of value to the ham. ELEC-TRONICS WORLD is slanted more toward the upper brackets of electronic readers and goes rather deeply into the engineering phases of the science of electronics. A good part of it is college level reading and offers much of interest to the ham who has progressed to that academic status and is seriously considering electronics as a career. The magazines I've mentioned are but a few of the current offerings and you'll find others on the newsstands. Aside from the strictly amateur class magazines, 73 and CQ, you ordinarily won't find other electronic magazines at your local ham stores but they are usually available at drug and supermarket newsstands. I'd say that you should take a little time now and then to thumb through these and make your own choice of those which may appeal to you. Whatever you choose is bound to teach you something, so you won't go wrong on any of them.

"Before we close this discussion of magazines though, suppose we examine their contents a little more in detail. In the three ham magazines the balance between construction articles and those of more general ham interest is about equal. Unfortunately, the larger proportion of their offerings is somewhat above the novice level of understanding although all of them try to devote a small number of their pages to a few elementary construction and discussion articles within the novice grasp. A strictly novice magazine does not exist . . . it probably could not exist were there such. A ham is a novice for a year at most, during which time he acquires sufficient knowledge to accept an increasing number of the more complicated articles with a

better understanding. He would then lose interest in a purely novice type of publication and quit buying or subscribing to one. Among the general class of electronic magazines, about the same situation exists; a considerable number of articles somewhat over the novice head. They too however, frequently run a construction article or two descriptive of something which the novice can readily build. To sum it up, my suggestion would be that you get one or more of the ham publications each month, preferably by subscription if you feel that you can afford it. Then round out your reading by doing a rather thorough thumbing through of the general electronics magazines on your local newsstands, buying those which seem to contain something of interest to you and perhaps even subscribing to one or two a bit later if they seem to offer you something of interest pretty consistently every month. So much for magazines then . . . let's look at something else.

"The 'something else' I'm talking about is your practical, daily novice operation on the air. You both have your feet wet now and have made a number of contacts. That indicates that basically you are are on the right road, but ten to one you're doing a number of things which will earmark a recently graduated novice the minute he legally enters the General class bands. For one thing, practically all novices overdo the 'period'. This is desirable while you are a novice; use every single character of the code that you can in your daily contacts to familiarize yourself with them thoroughly; you need not carry this over into your general class operation though. Most generals ignore the long series of characters making up the period; either they simply leave it to the other guy to know where one thought ends and another begins or they use a simple 'dit dit . . . dit dit' or a 'BT' to separate the thoughts. However, should you handle any third party messages, as in traffic net operation, you must transmit such messages exactly as written by the sender; if a period appears, it must be included. The majority of traffic nets however, rather than using the long drawn out characters of the period, substitute the letter 'X'. This is by common agreement and is well understood and interpreted by traffic handlers. In a message physically delivered to the addressee, the period should appear written as the conventional 'dot' however; not as an 'X' which could



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and your call three times, then CQ and your call *twice* and finally only once followed by the 'AR' or 'K'. Try training yourself this way . . . you'll gain more respect and more frequent replies from the generals when you enter their ranks. True, you'll find some of the experienced generals who are flagrant CQ'ers also but the rest of the gang generally pass them up as being 'too long winded' and they lose a lot of otherwise good QSO's they might have had.

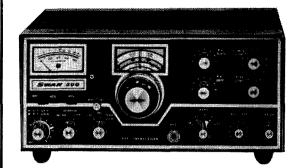
"There is another habit which seems to be a popular but asinine novice practice . . . oh I've heard it among a few generals as well; that is the childish habit of ending a QSO with an attempt at facetiousness by sending, "dit . . . dit dit dit . . . dit . . . then waiting for the other guy to come back with 'dit . . . dit'. That's kids' play; don't do it. And, one more critisicm of average novice operation and I'll be through with this 'one man lecture' panning you kids! That is the practice of acknowledging anything the other guy sends whether you get it or not by saying 'R., R., R., OK., OK', not only too many times but following it with, " . . . except I didn't get your handle and QTH, please repeat . . . " or words to that effect. When you send an 'R' it means that you received everything he sent; if you didn't get it all, don't say 'R' or 'OK'. Start right out after calling him by saying, "Sorry OM, missed a bit. Your handle and QTH again please" or words to that effect . . . make sense?

FN then rose from his comfortable rocker saying, "Well; that was quite a session, wasn't it? Sorry I had to make it so one-sided but what I gave you were a lot of little points which should help you keep going in the right direction. Now here are some leaflets I dug up for you which explain some of

the clubs I was telling you about; how to join, cost, etc. Study them over and make up your own minds which if any, you'd like to join. Paw through the magazines at the corner drug store and look over the 73 and CO at the ham shops down town. I've gone about as far as I can now to indoctrinate you into progressing up the novice ladder to the general class goal at the top. You're both more or less on your own now, but feel free to come out here any time; I'll be glad to see you, hear about your progress and help you with your little problems in any way you feel I can. So, run along now and get back to pounding out those CQ's but make' em short and skip the 'monkey business' on the air; get your teeth into some really serious communication . . . OK? I'll tune in on your frequencies every now and then so watch out you don't rile me" he finished laughingly. The kids then took off for their respective shacks and the novice field was richer by two new members in their ranks who had just had their ears pinned slightly back!

And so ends the saga of two new devotees to the glorious hobby of ham radio. In their climb up the novice ladder they had innoculated Judy's Dad with the 'hamitis' bug and he was successful in passing his novice exam after four months of what study he could manage between his family and job obligations. Judy and Joe continued their studies and at FN's suggestion, both faithfully followed the code practice sessions on the air from W1AW until they had acquired formal Code Practice Certificates from the ARRL at 15 words per minute. Both then appeared together at the FCC examining point for their general class license. Judy made it the first time but Joe flubbed his sending; he came through on top after the required 30 day wait. So . . . eight months scratch until Judy was a General . . . nine months for Joe! And, to carry the seed of ham radio even farther afield, Judy and her Dad undertook on their summer vacation to Aunt Emma's Kansas farm, to start Cousin Clara, a wheel chair invalid, up the novice ladder. Having adequate time to practice and study, Cousin Clara made her novice ticket in seven weeks and became a General class ham in seven more months and established weekly schedules with Judy and her Dad! Let's leave them all now to the continued enjoyment of the glories of ham radio . . . shall we?

. . . W7OE



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WTW Report

Things are progressing right along with the new WTW DX Award these days. If it's any indication of the interest in WTW, I am glad to report that the WTW country/tally sheets are going out at the rate of about 6 to 10 every day. If all these fellows are going out for the WTW certificates, there most certainly will be a lot of them issued in the future. If you are not already one of them, why not drop me a line, inclosing 20¢ in stamps, and I will send you a pair of the country/tally sheets so that you will more easily be able to keep your scores up to date. There is room after each prefix for a 10 year record for each of them. If everyone uses this standard report form, it will make our task a little easier, too, and thus eliminate the chances of making mistakes as more and more people qualify.

At the same time, each of the various QSL check points (they were listed in last month's report) will be using the same type of record keeping, so if it happens that some of them ever want "out", they can pass their records over to some other DX Club without the usual confusion of such a transfer of records from one group to another. Of course we at 73 Magazine hope none of them ever "wants out". The following stations have qualified since last month:

W4CRW-	-WTW-100-	14MHz	CW
W4FPW	-WTW-100-	14MHz	PHONE
DL5HH	-WTW-100-	14MHz	PHONE
W4JVU	-WTW-100-	14MHz	PHONE
W4BYB	-WTW-100-	7MHz	CW
К9ОТВ-	-WTW-100	14MHz	PHONE
K9PPX-	WTW-100-	21MHz	PHONE

In the above you will note there are two "Firsts"—The first non-USA WTW certificate goes to DL5HH (home call is WA4RMX) and there is Certificate #1 for 7 MC WTW-100 for W4BYB—Congrats to both of these stations.

Still wide open is certificate number one for any 28 MC operation, and certificate number one for both 3.5 MHz CW and 75 meter phone. At the rate the fellows are get-

ting on the band wagon it won't be long before someone gets these certificates. Better get in there and try for number one for these they are QRX for the first one who qualifies!

I again inform you that along with each application you must inclose \$1.00 to cover costs of the certificates, application forms, mailing of the certificate, etc. In addition to this, you must also send along enough postage for the return of your QSL cards-what ever amount you send that's how we will return your cards to you. Otherwise, they will be returned to you at the cheapest rate possible. This means very slow delivery and, at times, uncertain delivery-so don't blame us if something happens to your cards after they leave us on their way back to you. You can find out the exact cost when you send them to us, and for the safest possible way to get your cards back, send them by registered mail. The next best way is by certified mail, and after this is the old stand-by first class mail which costs you 5¢ per ounce. Please keep all this in mind when sending us your OSL cards.

We are still mulling over the idea of accepting QSL cards of less than multiples of 100. It would certainly make the listings more interesting, I am sure. Of course there would be more of a bookkeeping problem, but problems have always been something to overcome as they arise.

I am still waiting for some pictures of some of the fellows who have qualified for the WTW so we can tell the other fellow about you and your station. Make them good black and white pictures, fellows, since in the process of printing pictures, a little is always lost. Color reproduction is financially out of the question. The process of color separation is very expensive, so we are just sticking to good old black and white.

This is it for this month, fellows. Better get in the WTW and have yourself a "ball" and at the same time get a very low serial number on your WTW certificate, something you will be proud of as more awards are issued and the serial numbers get higher.

. . . W4BPD

Trindade Island DXpedition



At 8 o'clock in the morning September 10, 1965, I landed on Trindade Island with my ham equipment, courtesy of PY2PA, PY2PE, PY2PC, PY2QT and PY2BIK. This was the climax of a five year fight to operate from this rare spot in the middle of the South Atlantic Ocean.



Jac, PY2BZD/Ø on Trindade island.

At 3 o'clock in the afternoon the first CQ was sent and contacts were made on SSB with PY2PA, TU2AA, YV5BNW and PY2CYK. In the next four hours many European and stateside stations were worked—first stateside were W2MES on CW and WB2EPG on SSB.

Every operator was very excited and I knew they had been patiently tuning my frequencies day and night since September the first, awaiting my appearance on the air. I did everything to have as many QSO's as possible and in the first day of operations 161 stations from 23 countries and 4 continents were contacted.

Conditions were very fair during all 23 days of operations and the total QSO's reached 3200 with 108 countries. I hope on the next trip that the total number of stations contacted will be better and more hams will have a first DX QSO with Trindade!

Trindade Island

Trindade is a small rocky island on latitude 20° 30′ S, longitude 29° 22′ W, about 600 miles east of Brazil. The island has a volcanic nature and is shaped of high mas-

No—this is not St. Peter and St. Paul Rocks it's Trindade Island near Ponta do Paredao.



sive mountains with very little vegetation. The highest point, Pico Desejado, is situated about the middle of the island and has 600 meters height. The coast is abrupt and embroidered most of its length with coral reefs and erupted matter where the ocean harps impetuously. It was first discovered by Juan da Nova (a Spaniard working for Portugal) in 1501. He named the island "Ascensao", but later Estevao da Gama changed the name to Trindade. The British raised their flag on it several times (1700, 1781 and 1895) but in 1895 by mutual consent, the dispute between Great Britian and Brazil was submitted for arbitration to the King of Portugal, who decided in favor of Brazil.

The Brazilian Navy occupied the island several times during the first and second world wars. The island was abandoned a long time because there are many difficulties to land. During the Geophysical Year the Brazilian Navy built an Oceanographic station which is sustained by the Hydrography and Navigation Department.

Trindade is a rich fishy area and its sea has many kinds of fishes. The easiest to fish are the grouper, cavalla, badejo (similar to sea bass) and sharks. The fish "Pufa" or "Por-favor-me-pegue" (Please get me) is an ordinary fish and can be fished with a bucket or fish hook without bait!

In 1894 the island gained a momentary celebrity through the announcement by Baron Harden Ptickey who created himself "Prince of Trindade" but the Brazilian government made him desist of his plans.

The Pirates Treasure

According to legend, Lord Dundonald, commandant of the Chilean fleet, stole gold, silver and precious stones from the Lima Cathedral, but a pirate ship kidnapped Dundonald and fled into the Atlantic Ocean. Later the pirates were arrested and hanged

in Habana, Cuba, but they did not tell where they had hidden the treasure. Everyone believed that they hid it on Trindade. From 1822 to 1899 about twelve ships visited Trindade looking for the treasure but they had no success.

In September 1965 I landed but I did not discover the pirates' treasure either. I did convince my wife that I should come back to Trindade again to find it (a good reason to be out from home one more month to make the QSO's without any XYL-QRMMMM)!

Acknowledgment

Thanks are expressed to the Brazilian Navy authorities and radio hams PY2PA, PY2PE, PY2PC, PY2QT, PY2BIK, PY2CRJ, PY1BMH, K2HLB, WB2CKS and others, for their very considerable help (equipment, QSL's and encouragement) and guidance, without which this DXpedition could never have been possible.



Map of Trindade Island. PY2BZD/PYØ was located on the north side of the island as indicated by the arrow.

Gus: Part 27

Gough Island

Away we were now for Gough Island, some 300 or 400 miles further south towards that *cold* Antarctic continent. As we went south, a very noticeable cooling off of the temperature was noticed. I spent many hours on the air that night telling the fellows, "it won't be long now". We were going to be at Gough Island for a number of days.

Late the next afternoon I again noticed the thickening of birds on the horizon and about an hour later, Gough Island was in sight. It was almost a duplicate of Tristan except the high plateau looked a bit higher and the mountains seemed higher too. The birds were very numerous. Lots more than on Tristan, At sundown we anchored a few miles offshore. The water was too deep for anchors to do any good, so during the night the engines were run every now and then since we were drifting toward the island with no place to anchor. That was one night the radar and depth finder came in handy. They were both watched closely all night.

I was on the air telling the fellows where we were and saying I hoped the next day to be on land so I could give them a new country. I was very anxious to get on solid ground and get going with the "Gus Watchers" as they called each other.

The next morning we went ashore to see the weather station which was located down in a deep gulch between two mountains. It seemed like an odd place for a weather station to my way of thinking. I guess they had come to the same conclusion, as we had three pre-fabricated buildings on board which were to be unloaded at a spot about a mile south from the old station. The new location was right smack on top of a flat plateau, some 300 feet straight up from the water's edge. A knocked down derrick was unloaded from the ship in pieces and this was to be walked to the spot where they were going to build the new weather station. Eight men, 4 from the weather station and 4 from the ship, were going to walk that old.

beat up, rusty derrick across that rough terrain. They had a walkie-talkie with them to keep in touch with the ship's radio officer.

We all went back to the ship after looking around the island a little. We saw a number of seals, sea elephants (very dirty looking animals), and a few penguins here and there down at the water's edge. The penguins were rather wild and would head for the water when we approached. They would dive under and not come up until they were far out to sea. The old sea elephant was groaning and wailing away all the time and would snap at us if we got too close to him.

We had lunch on board the ship and then got in touch with the derrick crew to see how they were progressing. They said it would take all the rest of that day just to get the parts of the derrick to the place where it would be installed. I could see there would be no operating from land that night.

In order for the land crew to see where the ship was, they left the lights burning on board. This was a bad thing to do. Around midnight a crew member knocked at my door and told me to come out on deck if I wanted to see something unusual. Out we went and I saw the doggondest bloodiest sight I have ever seen. There must be millions of night birds around Gough Island and they were attracted to the lights. The lights were apparently blinding them as they were crashing into the shielded lights and the sides of the ship. Birds were scattered all over the deck with broken necks, broken wings, some had their heads knocked off. There was blood all over the place. It was very smelly and sickening to see those birds slaughtering themselves. The next day the whole ship had to be hosed down from stem to stern and the decks scrubbed to get rid of that fishy smell.

They finally got the derrick put together about 4 PM but by now the wind had changed and it was impossible to go ashore so I spent another night aboard the ship. I know the guys were disappointed and so was I. Man, I was itching to get on solid ground

and operate rather than just/MM.

Finally the next morning all was set and I was given the opportunity to be the first one ashore. We loaded the gear into the landing craft. All the suitcases with the radio equipment were well wrapped with oil cloth that W8PQQ had sent me months earlier. After a quick breakfast consisting mostly of Rock Lobster (I was beginning to get enough of that stuff by now), the landing craft was lowered and away I went. As we approached those straight up cliffs, they looked higher and higher. Finally I was right underneath them and they really did look high then.

We had the little walkie-talkie and called up to the fellows with the derrick and told them to let her down. Then sent down a big wire cage measuring about 12' x 12' with a veneer floor. This cage was opened up and I, along with all my junk, was loaded inside. Then the cage was locked from the top and could not be opened from inside. The signal was given from the top of the cliff to raise me up. Away I went. I was at least on my way to good solid ground. I wasn't too sure I was going to make it, though. I had noticed that the steel cable on the derrick was quite rusty looking, and boy . . . what a lot of creaking and groaning that thing made as it was being raised up. Here I was like a wild animal, locked inside a cage being raised by a pre-historic looking derrick, on a strange island in the South Atlantic. Sometimes these fellows on a DXpedition will do almost anything to give the guys a "new one". I am sure this DXpedition would have come to a sudden stop if that cable had broken while I was being lifted ashore. Was I afraid? You said it, Ole Buddy, 1 was! And that is putting it mildly, too.

On the way up, I had a chance to notice all the bird caves in the side of the cliff. There seemed to be a million of them. In each one, there was a bird or two and they looked out at me and let out a few squawks as I went by. I waved at them just to be sociable. When I was about halfway up, I looked down at the ship. It looked very small and far down. The wire cage sure would have made a big splash if that cable had broken and had sunk to the bottom of that rocky lagoon. For me, it would have been "goodbye world".

It seemed to take forever to bring me to the top. I guess it was really only a couple of minutes, but it seemed much longer. When the cage finally reached the top it was swung away from the water; it was sure good to be over dry land again. I was lowered and stepped out of the cage as it was unlocked. At last I was on solid land and the QSOs I was to have would count for the DXers again. The men on shore were all interested in what I was doing even though they could not understand why I went to all that trouble just to put a ham station on the air from Gough Island. I explained to them that I could use a little help in putting up my tent and erecting the 40 foot sail mast I had taken ashore. They all pitched in and in a couple of hours I was ready to go.

I tuned up the rig, did a little juggling of the lengths of the ground plane wires to get the SWR down. On 40 meters from 7000 to 7200 it was not higher than 1.2:1 and it was even better on 20 and 15. I had found that by cutting two ground plane wires to resonance on each band, this was not hard to do. The signals from ZS and LU sounded like locals. I had just finished tuning up on 14065 and didn't even sign my call when Marge, ZS1RM tapped her key a few times just saying, "Gus?" Back I came, and gave her the first OSO from ZD9AM. She was 599+. From then on, I worked them like mad. First a batch of ZS stations and after them quite a number of LU's, PY's, and then all over Europe. After that the W/K stations had their turn. It was like shooting doves in a baited field. The band sure was in great shape considering the sun spots were down. In fact, the band came near to staying open all night, ending with a few QSOs with VE8 and some KL7's. I could see things were going to be very FB from this location and hoped they would continue the same when I got further south in a week or so.

When the sun went down it got downright chilly. A damp southwest wind would start blowing and it felt like it was coming directly from the South Pole to me. I had brought a pair of red insulated long handles with me, so I stayed pretty comfortable.

The cooking chores were taken care of by the crew who were there to install the new weather station. These South Africans are heavy eaters, and they took to the Rock Lobster like ducks to water. As for myself, I got to the point where I didn't want that white meat all the time. That's when I began eating some of the canned goods I had brought along with me. I did not think pork and beans could taste so delicious and a few

cans of those beans with little franks were "out of this world"!

I stayed up almost every night all night long and slept most of the day. Quite a nice way for a fellow who likes DXing as much as I do to spend the time. The funny part is, I never did get tired of this even though after a while it took on the aspects of a "job". But it was an enjoyable job, I must say.

The stay at Gough was supposed to have been for 5 or 6 days, since this was the time required to assemble those pre-fab houses we brought from Capetown for the weather station and the staff. The bad weather had not been considered at all in their plans. Every morning just at the break of day, the sea looked very fine, but before the first barge could be filled with parts of the prefab buildings, the wind shifted and increased to the point that landing the barge and loading up the wire cage with material was impossible. This thing kept up for 17 days. During this time they could only bring in a barge once in a while. Finally, everything was ashore and put together and we were all glad it was over. I had just about worked the bands dry and even had to call CQ two or three times to get a contact. When it gets like this, it is time for a DXpeditioner to move on, and that is just what I wanted to do.

The night before the departure I got the message to be ready to depart from the island 30 minutes after sun up the next day. I packed up all the equipment and got things torn down and was ready when the ship sent the landing barge to pick me up from the wire cage. Again I took the trip in the cage and again I was very much afraid the cable would break and end the DXpedition. But, I made it and was much relieved to set foot on the barge safe and sound. I was sure glad to leave Gough Island and the birds there.

There was some question about our going to Bouvet Island, since the Captain of the ship had been requested to tow a disabled lobster boat back to Capetown. It looked as if Bouvet was going down the drain until I contacted Brian—ZS6ANE. I asked Brian if he had any pull with the big man in Pretoria. He told me not to worry and made a schedule for five hours later. When the sked time came, Brian was right there and said he had good news for me. We were definitely going

to Bouvet. This was confirmed by the First Mate who told me we were now headed for the island after all. This was great news for me. I immediately got on the air and told the fellows the news. Then I pulled the switch to the rig and wandered up to the poop deck to chat with the man at the wheel. When I first entered, he told me we had changed direction and were headed for Bouvet, which he called the land of ice and snow. He said I had better have lots of warm clothing . . . as much as I could walk in. He said it was the most unhealthy and the coldest place in the world. He told me he wouldn't go there for a thousand dollars and I was in for a rough time if I planned to land. I told him landing on Bouvet was the reason I had come on this trip and nothing was going to stop me. This little talk with this man made me want to go there more than ever. I like these challenges.

When the sun went down that afternoon, I went on deck to watch the stars and I could see the Southern Cross had risen a little higher in the sky. The winds became a little colder and more brisk and the dark blue of the sky even looked clearer and had a sort of cold look about it. The waves were even more choppy than usual.

Oh yes, before I forget, let me tell you of one incident which happened while I was on Gough Island. After I had been on the island a few days, three Russian Whalers anchored a few miles from our ship. With field glasses we could see they were watching us. The radio operator on our ship tried calling them a few times but couldn't get any answer. After a while he called an imaginary group of American whalers supposedly coming to Gough Island. He gave them a line about OK . . . we'll be expecting five ships here tomorrow morning. The result was the Russian ships departed before morning. So, you see, hams are not the only ones who have QSOs with "ghost" stations. I remember one time when the band was dead and just for the heck of it I called AC4YN and had a "QSO" with him. When I signed there were 5 stations calling him. Two of them were fellows who were near the top of the DXCC Honor Roll, too! One of them called me and asked me if AC4YN had come back to him! There are always interesting things on the band if you listen for them.

. . . W4BPD

DX'ing

If you haven't gotten into the DX game yet, but would like to start, here are some techniques that will get you off on the right step.

DX'ing is, with many, much more than a hobby, it is an obsession. They buy their houses in good DX locations; they have jobs that permit them to stay home on occasion to catch a rare new country; their vacations are planned for times when they are sure that no new ones will be on, and even nights out to visit friends can be cancelled at the last minute if something new is heard on the bands. Most ham's wives suffer, but the wife of a DX chaser suffers the most.

Working DX means different things on different amateur bands. On the very high frequencies a contact over 100 miles may often be the cause of great rejoicing. On the short waves a contact with the other side of the earth is a mundane occurrence. The great bulk of the serious DX hunting is done on the twenty meter band. Next comes fifteen meters, then ten meters, then forty, eighty and, finally, one hundred sixty meters.

Let's talk first about twenty meters. Here the DX game means, in essence, contacting as many different countries as possible. There are the easy ones and there are the hard ones. Countries like Germany and England, with thousands of licensed amateurs, are no problem, except that they often are around in such profusion that they may obscure some of the rarer countries. Some countries are so small or backward that they have no amateurs in residence. Some have just one. With perhaps 20,000 amateurs playing the DX chasing game, a single amateur in a country is kept extremely busy providing even one contact with everyone that wants him.

We'll talk later on about what an operator in a rare country can do to keep things orderly and protect himself from being called by hundreds of stations all at once. Whether the situation is one of order or chaos is entirely in the hands of the operator in the rare country.

Perhaps we should consider motivations just briefly here. To some operators just the contacting of stations in different countries is enough. Others are interested in having a chance to sit and chat with the rare country. But the great bulk of the DX'ers are after a QSL card confirming the contact which they can display on their wall and send in for an award.

There are hundreds of awards available. As a matter of fact there is one fellow who publishes a quarterly bulletin listing the new awards. And there is a Certificate Hunters Club made up of fellows who are trying to get as many awards as possible. The two main awards today are the DXCC, the DX Century Club, and the WTW, Worked The World. The DXCC is awarded by QST magazine and WTW by 73 magazine. Both require the contacting of 100 different countries for the basic award. And then there are further awards as more and more countries are contacted. We'll give you the detailed rules for these two awards later.

If you stop and give the matter some thought, you can probably see one of the basic difficulties that these awards have brought out. This is the question of what is and what is not a country. This has gotten to be a very involved situation and has, as yet, not been satisfactorily resolved. QST makes its own decisions as to what they will count as a country for their award. 73 leaves the decision up to the national radio societies around the world. So we have the rather ridiculous situation of little reefs that come out of the water at low tide in various spots around the world being counted as new countries. And we, of course, have amateurs rushing by boat to these wet reefs to set up their stations for a few days and give everyone contacting them a contact with this new country. Who pays for this? Why, the overjoyed fellows who have upped their country score, naturally. It is all on a donation basis, to be sure, so the chap sitting on the wet rock is not technically receiving remuneration for his trip.

The station equipment

Let's suppose now that you are interested in winning one of those wonderful DX awards. It stands to reason that the better station you have, the easier it will be to get your 100 or more QSL cards. Oh, you can manage it with low low power, a poor antenna and only a few minutes a day. But you may be a lot older than you are right now when you finally make it. If you are like the rest of us you are impatient. You want to get right at this challenge. You don't want to spend years doing a few weeks work.

You're going to need four things if you are going to make a name for yourself in the DX world. You're going to need a good rig, a good antenna, a good location, and enough time. We'll take those on one at a time.

Despite the many kilowatt rigs on the market, most of the amateurs are still running a lot less than the legal maximum. Some feel it is more sporting . . . some are saving money . . . some have just been putting off buying the new rig. I think I should level with you about a fact of amateur radio life: you need all the power you can get. Please don't start arguing with me. You'll have more than enough problems even after you've come up with one of the outstanding signals from your area. You want everything going for you that you can control. Look here, I've operated from over there . . . and believe me, if you are running any less than the full book and a good beam you just aren't going to be heard most of the time. In Afghanistan you can hear the loud stations six nights out of seven. You hear the medium powered stations one night out of seven. And you hear the low powered stations just a few nights a year. How long do you want to have to wait to work Afghanistan?

The rig

You may prefer a separate transmitter and receiver. For my part, I find that the bulk of the contacts are worked right on my own frequency and thus a transceiver is a lot handier than separate units. You can waste a lot of time zeroing in on your receiver when a rare one has just called a CQ or signed with someone else. You could miss him. There are times when you want to be able to split your transmitter and receiver, so be sure that your transceiver will do this and spend the few dollars extra for the remote VFO.

Some of the transceivers today run 300 to 400 watts. Don't for a minute think that this is going to be enough. You want a good solid kilowatt linear on the end of that transceiver. There are several excellent units on the market. As a rule of thumb. the larger the linear, the more power it will run. Once you have one of the big babies you will have to be careful . . . they are capable of running a little more than the legal limit. Keep one eye on the final plate meter and don't let it get up above 2000 watts PEP. If you forget it for a while you may find yourself talking into the mike a little louder than usual and the meter going on up to 5000 watts PEP. Shame! You don't have to run overpower if your antenna is perking satisfactorily.

Did I hear someone complaining that this is getting too expensive? Come on now. A good transceiver, complete with calibrator, power supply and remote VFO can run a bit under \$600. That's brand new, and not counting any trade-ins or discounts. The linear might run \$700. \$1300 for the pair. About what you might spend for a good camera or a small boat. Even a couple of good guns would run you that. There just aren't very many hobbies where you can be a top gun for such a modest investment. Statistics show that the average amateur has over \$3000 invested in his station . . . the problem usually is that it wasn't invested to the best advantage. You can blow a lot of money foolishly in ham radio too, with not much to show for it in results.

You're not finished yet. There is still the matter of the beam. And that beam should be up there about 70 feet in the air. Please don't bug me with verticals or anything like that. You want a signal that is going to be heard. This means that you're going to have to put up a three element quad or a three element beam. If you are willing to settle for just one band then I'd favor a full size three element beam for 20 or a four element for 15 meters. Unless you are going to have an awful lot of time available for DX'ing you might just as well settle down on 20 meters. This one band

will keep you plenty busy. Besides, you certainly don't want to mix countries worked on different bands. A three element full sized 20 meter beam costs about \$70. That isn't too bad, is it? You can get by for less with a quad or a home made affair. And if you do for some obstinate reason insist on working two or three bands then you might do very well to consider the quad. Tribander yagi beams do work out well, but usually a single bander will override them.

Figure about \$20 per ten feet for the tower. That's about \$120 for the 60 footer plus some extra change for guy wires and accessories. And another \$100 for the rotator. \$300 will pretty well take care of your beam, tower and rotator.

There you go. For about half the normal ham investment you can have an outstanding station capable of working the world . . . one that will get you through the QRM most of the time. Even on the rare ones you won't have to wait very long . . unless some more fellows happen to heed this.

The QTH

Not very many operators are going to move to a better location just because they've contracted the DX bug. But it seems to me that I saw figures once which showed that, on the average, everyone moves about once every five years. Our experience with address changes for 73 seems to back this up . . . and the Callbook magazine agrees that hams, too, do move around a lot. At any rate, when you do make that five year move you might give some consideration to the location of your new house from the DX standpoint. It might be prudent not to say anything out loud about this aspect of your selection, to keep down friction with the wife.

We still have some things to learn about ideal hamming locations. It should be fairly obvious though that you are going to be at a disadvantage if your antenna is pointing into the side of a large mountain or a building. If you are going to have to live in a metropolitan area you can subtract at least one S-unit from your signal reports . . . and from the received signals. The buildings and pavement will absorb that much. You'll probably have fits with the noise all those other people generate too. The garbage on your dial at night can

bring you to tears . . . television oscillators . . . diathermy . . . electric razors . . . heating pads . . . the supply of noise is endless. There really is a lot to be said for the suburbs.

Keep an eye pealed for a house with a big enough yard to contain a full sized twenty meter beam. And if you are renting, don't forget to get written permission for your tower. And check to see if there are any restrictions in the neighborhood against towers . . . many communities have these.

An ideal spot would be on top of a good sized hill with a high water table, a good clear shot in all directions, and no neighbors for a mile or so in every direction. See what you can do about that. Sell your wife on the fabulous privacy. Better be sure you're not too close to a main highway either, you don't want all that ignition interference. It is safer for your dogs and cats too.

If you do have to live in the city . . . and most of us do . . . then how about moving into an apartment that will let you put your beam on the roof. Get it in writing. The last one I rented was all cooperation until I had signed the lease and then the landlord had no further recollection of any beams or ham antennas.

Some fellows believe in leaving nothing to chance and take the time to check out the proposed new location with a mobile receiver to see if it is going to work out OK. This can be helpful. You could just accidentally pick a site on top of a dry hill or even one filled with ore and wonder where the signals went. I remember the summer I set up a ham shack in a fabulous location up in northern New Hampshire. There were acres for antennas, only one house within miles, and it was at the end of a long road, way away from the highway. This should have been a hams heaven. I put up long wires, dipoles, and even a rhombic trying to get signals in and out of that spot. I worked out better with my mobile from downtown Manhattan than I did from that beautiful mountainside in New Hampshire. On twenty meters I did, using the rhombic, manage to contact England. On ten meters I got an S-2 from Australia once. On 75 meters I worked for weeks to get a contact down in New York. Talk about frustration.

Funny thing about that place. Back in the 30's W1CUN used this same shack.

I suspect that he may have suffered the same difficulties I did, for he became one of the pioneers of ten meters. Was it frustration that drove him up to ten?

The water table is high at my present location and the ground is good. You have to be careful not to stamp too hard or the dent fills with water. I work out incredibly . . . and I strongly suspect that this has a lot to do with it. When I was W4NSD down in Virginia I had the same sort of ground and I managed all sorts of interesting DX from there with a simple dipole thrown into a tree about ten feet off the ground.

The way I look at it is this . . . ham radio is a hobby that usually sticks with you for your lifetime. Now, if you are going to be enjoying ham radio for years why not make the extra effort when you buy a house to give yourself the best possible advantage? When you move next time get yourself a good DX'ing location.

Time ·

It takes time to work 300 countries . . . a lot of time. You have to be pretty dedicated to get this many worked. But if you have a good signal and can put in two or three hours a day on weekdays and perhaps six or eight a day on weekends, you should be able to work your first 100 countries in about two weeks. By the end of a vear vou should be well over 200. Your success from then on depends on how avid you are, The rarer ones don't come by accident. You have to keep in touch with the other DX'ers and find out when they will be on, their frequency, and so forth. You have to subscribe to the DX bulletins and use their info as a guide in listening for new ones.

When we announced the WTW award we set a starting date of May 1966 and all contacts had to be after that date. The first fellow to turn up with 100 countries contacted and QSL'ed was Gay Milius W4NJF and he managed this within two months. W5KUC turned in cards for 200 countries contacted and QSL'ed after only six months. This shows what you can do if you put your mind to it and have a reasonable signal to back up your determination. One year after the start of WTW at least two stations had contacted 300 countries and only a few straggling QSL's were between them and the certificate.

Fortunately for those of us that have to work for a living the best DX'ing hours don't conflict too seriously with bread-winning. On twenty meters you can get most of your best DX'ing in during the evening hours. It doesn't hurt to get on in the morning too for an hour or so before breakfast. The DX pattern changes with the seasons. At one time of the year you will hear South Africa in the late afternoons, at others it will be Europe or the middle East. A few days on the air and you get used to the pattern and have a good idea of when you can work where and which way to point the beam.

Luckily, weekends are the busiest times all over the world on our bands and you will find that weekend time devoted will usually give you more results than weekdays. DX'peditions usually try to operate over the weekends too.

It does pay to keep track of the various times around the world. The bands are open to a lot of areas that we don't work merely because no one happens to be on there at the time. If you have a clock that indicates the time at different spots around the world it will be helpful to you. The fellows will, usually, be on the air at around 6 pm their local time. There is little to be gained in trying to work them at 4 pm their time for they are still at work. And after 11 pm most of them are in bed. When a good strong DX'pedition station opens up from a rare spot we appreciate this factor for we find that we are able to work him almost around the clock. Of course his high power makes a big difference on this too. In my travels around the world I've tried to encourage DX stations to put on as much power as they can. Most of them are not really aware of the difference that high power makes in the number of hours that the band would be open for them. They haven't really realized why it is that they can hear my signal for 16 hours a day, but can only get through to me for two or three hours. This can be extremely frustrating for the DX operator. Imagine yourself in some out-ofthe-way spot where you know that thousands of stations would give their eye teeth for even a ten second contact with you . . . and absolutely no one comes back to your CQ calls or to your attempts to call stations who are in QSO. They just aren't hearing you.

. . . W2NSD



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Propagation Chart

SEPTEMBER 1967

ISSUED JULY 5 J. H. Nelson

EASTERN UNITED STATES TO:

GM T:	- 60	02	94	(16	08	10	12	14	16	18	20	32
ALASKA	14	14	14	7A	7	7	7	7A	14	14	14	14
ARGENTINA	21	21	14	14	7A	7	14	14	21	21	21	21
AUSTRALIA	14	14	14	14	78	7	7	7A	7A	7B	14	14
CANAL ZONE	21	14	14	14	14	7	14	14	14	14	21	21
ENGLAND	14	14	7A	7A	7	14	14	14	14	14	144	14.
HAWAII	14A	14/	14	14	7	7	7A	14	14	14	14	14
INDIA	14	14	14	7B	7B	7B	14	14	14	14	14	14
JAPAN	14	14	14	7B	711	7B	7B	14	14	14	14	14
MEXICO	144	14	14	14	7	7	14	14	14	14	14A	14
PHILIPPINES	14	14	14	7A	7B	78	7A	14	14	14	14	14
PUERTO BICO	14A	14	14	7A	7	7	14	14	34	14	14	14/
SOUTH AFRICA	78	7В	78	14	14	14	14	144	21	21	14	14
U. S. S. M.	14	14	14	14	7A	14	14	14	14	14	14	14
WEST COAST	14A	14A	14	14	7	~	7A	14	14	14	14	14

CENTRAL UNITED STATES TO:

ALASKA	14	14	14	14	7A	7	7	7A	14	14	14	14
ARGENTINA	21	21	14	14	7A	7	14	14	21	21	21	21
AUSTRALIA	14	14	14	14	14	14	7	7A	7A	7B	14	14
CANAL ZONE	21	14	14	14	14	7.4	14	14	14	14	21	21
ENGLAND	14	14	7 A	TA	7	7	14	14	14	14	14	14A
HAWAII	14A	14A	14	14	14	14	7A	14	14	14	14	14A
INDIA	14	14	14	14	713	78	7B	14	14	14	14	14
JAPAN	14	14	14	14	711	76	78	14	14	14	14	14
MEXICO	14	14	14	7A	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	7A	78	7B	7A	14	14	14	14
PUERTO RICO	21	14	14	14	7	7	14	14	14	14	14A	14A
SOUTH AFRICA	7B	711	7B	7.A	78	14	14	14	14	14	14	14
U. S. S. H.	14	14	14	14	7	7	14	14	14	14	14	14

WESTERN UNITED STATES

ALASKA	14	14	14	14	7A	7	1	7	34	14	14	14
ARGENTINA	21	21	14	14	7A	7	14	14	21	21	21A	21
AUSTRALIA	21	21	21 A	21	14	14	14	7A	7A	7B	14	21
CANAL ZONE	21	14	14	14	14	7	14	14	14	14	21	21
ENGLAND	14	14	7 A	7A	7	7	7	14	14	14	14	14
HAWA11	21	21	21A	21	14	14	14	14	14	14	н	21
INDIA	14	14	14	14	14	7B	7B	74	14	14	14	14
JAPAS	14	14	14	14	14	14	7B	7.4	14	24	14	14
MEXICO	14A	14A	14	14	14	7	7	14	14	14	HA	14A
PHILIPPINES	14	14	14	14	14	14	7B	7A	14	14	14	14
PUERTO RICO	14A	14A	14	14	7A	7	7A	14	14	14	14	14
SOUTH AFRICA	711	711	713	7A	713	7B	14	14	14	14	14	14
U. S. S. R.	14	14	14	14	7	78	7B	14	14	14	14	14
EAST COAST	14A	14A	14	14	7	7	7A	14	14	14	14	14

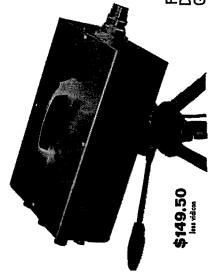
- A. Next higher frequency may be useful this hour.
- B. Very difficult circuit this hour.

Good: 1, 4, 5, 8, 9, 11, 12, 20-25, 28, 30

Fair: 3, 6, 7, 10, 13-15, 17, 26, 27

Poor: 2, 16, 18, 19, 29

VHF: 22-25, 30



* Made in USA - Model XT-1A, series c

Broadway



Knight KG-663

Regulated DC Power Supply

If you're experimenting with transistors and integrated circuits these days, you need a good reliable variable dc source—regulated, stable and usually, pretty *stiff*. The new Knight KG-663 Regulated DC Supply fills all of these requirements plus several interesting features not usually economically available to the amateur or experimenter: current limiting, short-circuit protection, and remote programming and sensing.

The KG-663 features variable voltage from zero to 40 volts and variable current limiting up to 1.5 amperes with a completely solid-state circuit. The basic power supply consists of a dual full-wave rectifier and capacitive filter system and a series regulator. A dual potentiometer across the output is used to adjust the voltage; the dual feature permits both coarse and fine control of the output voltage. The voltage adjust pots actually control the base bias on the error detector transistor. The emitter of this transistor is maintained at 0.9 volts by a bias reference source. Once the voltage adjust knob is set, any change in output voltage is detected by the error detector, amplified by the error-amplifier transistor, and adjusts the series-regulating transistors to compensate for the change.

Since this action is almost instantaneous, the regulator action provides additional filtering action and reduces ripple on the output to a very low level. Capacitors connected across the voltage-adjusting pots make the error detector much more sensitive to ac ripple components. The result is a supply which exhibits less than 0.6 millivolts rms (0.0006 V rms) ripple, even at the full-rated load of 1.5 amps.

If the output of a regulated supply is short circuited, the regulator tries to main-

tain the output voltage present before the short occurred. Since the current quickly reaches very high values with a short circuit across the output terminals, the supply will burn out if it is not protected in some way. Fuses have been used for this purpose, but their action is usually so slow that the semiconductors in the supply will be destroyed before the fuse blows.

In the KG-663 this sad series of events is curtailed by a current-limiting circuit. The current-limit transistor samples the output current and is normally cut off. If a short circuit occurs with the current-limit control set to maximum, the current-limit transistor is turned on, removes control from the error detector and error transistors, and biases the series regulator transistors down to the point where two amps is maintained. This is a safe current level for a limited time. When the short circuit is removed, the output voltage returns to its preset value. With this circuitry, the KG-663 supply is not damaged by external short circuits. The current limit control permits the maximum current to be adjusted from two amperes down to 100 to 200 milliamperes.

In addition to current limiting, protection is also provided for reverse voltage. A diode connected across the output terminals protects the electrolytic capacitors and series regulator transistors from externally applied reverse voltages. This reverse voltage diode is particularly important where two or more supplies are connected in series for higher supply voltages. If, in this case, the ac power is removed from one of the supplies and not the other, the protective diode prevents damage to the unenergized supply which would result from a reverse

polarity.

If two or more KG-663 power supplies are connected in parallel to provide more output current, the series-regulator transistors must be protected from reverse voltages. This is accomplished with a diode connected across them. The only other requirement for operating these supplies in parallel is to connect a 0.1 ohm, 1 watt resistor in the positive lead of each supply. Then each of the supplies must be adjusted to exactly the same output voltage. This may be confirmed by connecting the positive leads together—there should be no deflection of either voltmeter.

Two interesting features incorporated into the KG-663 supply are remote error sensing and programming. These items are usually found only in very expensive commercial units. For most applications the load is connected to either the front-panel binding posts or the rear output terminals, but in some cases the load must be separated from the power supply by a relatively great distance. In this case the remote sensing feature can be used if precise voltage regulation is required.

The regulator will maintain the voltage at the output terminals, but if long leads are required to the load and the current is high, there may be a significant voltage drop. To maintain the desired voltage at the load itself, external voltage sensing leads may be connected across the load. These leads are connected directly to the voltage adjusting controls and error detector transistor. Since they only carry about 10 milliamps, 22 gauge or larger wires are sufficient. With the external sensing connected, the power supply compensates for line loss due to lead resistance and a constant voltage is maintained at the load.

In some applications it may be desirable to control the output voltage from a remote point. This may be accomplished with the KG-663 through the remote programming feature. Basically, an external 4000-ohm voltage-adjust potentiometer is connected across the remote programming terminals at the rear of the supply. If desired, both the remote programming and remote error sensing may be used simultaneously.

Although the current-limiting circuitry provides sufficient current regulation for most applications, in some cases precise current regulation is required. This may be obtained in the KG-663 with an external

Knightkit KG-663 Specifications

Output voltage: 0-40 volts. 0-1.5 amperes. Output current:

Less than 60 millivolts (0.6 V) Output load from no load to full-rated regulation:

haol

Line regulation: Less than 0.3 volts change under all load conditions. Ripple: Less than 0.6 mV rms at full

load.

Output impedance: Less than 0.1 ohm from dc to

10 kHz: less than 0.5 ohm to

100 kHz.

Current limiting: Continuous, adjustable from

front panel.

Short-circuit protection: Features:

Continuous dissipation type. Remote error sensing, remote programming, precise current regulation, positive or negative ground, may be stacked for series or parallel opera-

tion

Semiconductors: Meters: Size and weight:

Price:

6 transistors, 11 diodes. Voltage and current. 7¾ x 7½ x 10¾ inches. 16

pounds.

Power requirements: 110-130 volts, 50/60 Hz, 20

watts at no load; 110 watts

at full-rated load.

\$99.95 kit; \$149.00 factory assembled.

current-sensing resistor and the external sensing feature.

Assembly of the Knightkit KG-663 is very straight forward and only requires three or four evenings work. The instruction manual is well laid out, well illustrated and easy to follow. If you have not assembled a Knightkit before, you will be pleased with the ease with which they go together and the high quality components used. For example, instead of providing several rolls of hookup wire, Knightkit furnishes labor-saving precut and stripped lengths. Wiring errors are practically eliminated by the prepower resistance checks and preliminary tests outlined in the construction manual.

The KG-663 variable dc power supply is a very versatile unit which should find a lot of use on the amateur's bench. The 1.5 ampere capability of the supply is particularly useful when breadboarding integrated circuit projects. The 0-40 volt output meets almost every requirement for transistor work. In addition, the current-limiting circuit may save that expensive transistor circuit you're working on. These features, coupled with the remote error sensing and programming, comprise a power supply that's hard to beat in terms of versatility, regulation, convenience and cost.

. . . W1DTY

95



Mort Waters W2JDL 82 Boston Avenue Massapequa, Long Island New York 11758

Heathkit SB630 Control Console

The old saying about good things coming in small packages could have been written with Heathkit's SB630 console in mind. There are four operating conveniences in this one compact unit—SWR bridge, hybrid phone patch, 24-hour digital clock and an entirely independent 10-minute timer which reminds you when it's time to identify. This last provides you with a choice of a brightly lit *identify* on the panel, or the internal buzzer may be switched on so that light and sound both remind you that it's time for a station break.

Styled to match the rest of the ever-growing Heathkit SB-family, the SB630 can, of course, be used with any gear. Panel height is identical with the other Heath units, but a variety of feet come with the kit to let you change it to whatever suits you best.

SWR bridge

The hardware and circuitry of the built-in bridge appear to be identical to the HM-15 SWR meter. Two sets of resistors are supplied with the kit, allowing use with either 50-52 ohm or 70-75 ohm transmission lines. It's a good idea to keep the unused resistors handy; you can tape them to the chassis in

case you decide to change feedlines.

For full scale forward deflection on 75 meters, 70 watts of output are required but as frequency rises, less power is needed. At 6 meters only 2 or 3 watts pin the needle when the sensitivity pot is wide open. Despite these requirements, the bridge can be used at lower power levels too, with some slight loss of accuracy. If for example, the forward reading is only 50% of full scale, the indication of reflected power is proportional.

Perhaps even more important than any discussion of the bridge's characteristics is the manual's lucid and concise explanation of SWR and line losses, and what they mean to the amateur.

Phone patch

The SB630's meter has two functions—SWR, as already mentioned, and the indication of phone line listening level. When the mode switch is turned to **phone patch**, the meter reads accordingly.

In addition, there's a two-position slide switch on the rear apron. At the monitor position, which is where you'll normally use it, the meter indicates signal level on the phone line, so you can set the gain to avoid

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crosstalk on the line. The other position, null, is optional if you want to work patches with VOX control; even then you only use it once, following a simple null adjustment procedure described in the manual. In this position of the switch, meter sensitivity is increased, making it easier to find the null. Once set, it should need no further attention.

Ten-minute timer

The circuit of the identification timer is very interesting. Three resistors and two capacitors comprise an RC network with a very long charge time. When this charge reaches a critical point, it causes a neon bulb to conduct, sending a positive pulse to the grid of a 6EW6 relay control tube, energizing the relay. Several things then occur.

One set of contacts lights the pilot lamps (and sounds the buzzer—if the front panel switch has selected this option). Another set of points lets a capacitor discharge through a pair of resistors to hold the grid positive for about a second, the time in which identify lights up and the buzzer sounds. In passing, I found this cycle too short to suit me, but it took only a few moments to add another capacitor across C25 to increase the hold-in time. I could have changed a resistor (R27) for a higher value to get the same results, but the capacitor was easier to get at.

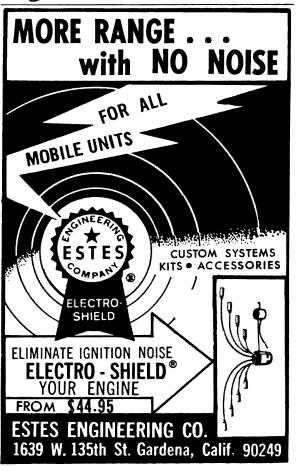
A third pair of contacts discharges the timing capacitors. When the contacts reopen, the 10-minute timing cycle begins all over again. You expect a regulated voltage source in this circuit if there is to be any accuracy. There is one—an OA2 gives you 150 volts of regulated voltage.

Adjustment of the timing is simple and quick. There's a "coarse" control you set once. Then touch up a "fine" adjustment until you have a cycle of exactly 10 minutes. Although broadcast studio precision isn't a necessity, you can get it easily. On the very first try, I got the cycle to 9 minutes, 57 seconds. Two touchups later I had it right on the nose. As this is written, following about 3 weeks of use, it has held its calibration perfectly.

To use the timer, touch the reset button on the panel at the beginning of each QSO, to start the 10-minute cycle. The 24-hour clock runs all the time, of course, completely free and independent of the ten-minute timer.

. . . W2JDL



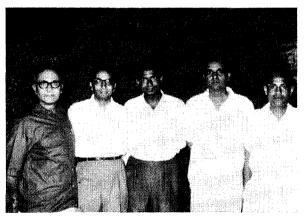


(Continued from page 4)

Raju (VU2NR) and Colin (G3MUR) were waiting for me when I staggered out of customs. Colin had his car and drove us first to his place for a lunch and then on to the Janpath Hotel where they had reserved a room for me. The room, with breakfast, was \$3.60 a day and it was nice. It was air conditioned, thank heavens, and had a small dressing room, shower and fairly large bedroom with a fan built into the ceiling, like in the movies.

After I had unpacked we drove on to Raju's house on the outskirts of New Delhi. Delhi is an enormous city, consisting of about seven cities in a cluster, each a little newer. The newest section of this thousand vear old group is New Delhi. It has wide streets and modern buildings. The great bulk of it was built by the government and I gather that most of the people living in the houses are, like Raju, government servants. Raju services the electronic equipment for the airlines. He has a quad on the roof, but is afraid to put up anything lasting because he expects to get a raise before long and then he will be moved to a new apartment.

Raju is one of the few Indian amateurs active on SSB. He, like most of the others, built his own equipment from surplus. The receiver is a converted Command Receiver; the kind we buy here for about \$5. The transmitter was all home made and most of the parts looked as if they had been used many times before they came to Raju. Amazingly enough, it works. I went on the air and made a few contacts, just to see how it went.



Dar VU2BX, Karnik VU2CK, Raju VU2NR, Amar VU2CZ, and Verma VU2OP, officials of the Amateur Radio Society of India.

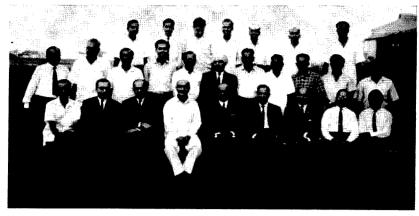
A reception had been arranged for the evening so we stopped off at the hotel and I put on a white shirt with long sleeves. I always take along a white shirt, tie and jacket on my trips in case I get into something where my usual sport shirt isn't quite right. Most of the active amateurs in Delhi were there for the reception, along with some of the government officials. I had a good chance to explain about amateur radio in America and point out to them the importance of encouraging amateur radio in India if the country were to build up the technicians it would be needing for the development of electronics and communications in the future.

Dr. Sarwate, the Secretary General of the ITU, was there and we had quite an interesting chat. I suggested the possibility of a set of amateur radio regulations being drawn up as an ITU standard which could be suggested for the newer countries. This would put amateur radio on a more official basis with the ITU, and could give us a standard set of regulations which would be world-wide. Dr. Sarwate thought this would be an excellent idea and hoped that the ITU might be able to set up a committee for such a program. He was very interested in my explanation of the basic importance of amateur radio to emerging nations and said that although he was aware that amateur radio was of importance for emergency communications and for the development of new ideas and inventions, he hadn't appreciated the possibilities it had for the training of technicians.

Mr. Lal, the head of the PTB, the Indian counterpart of our FCC, was there, and he also was interested in this aspect. I made arrangements to get together with him later for more discussions along this line and to see if we could start things going for the possible helping of Indian amateurs with American ham gear. I also talked about this idea with Colonel Rai, the president of the Amateur Radio Society of India (ARSI), as he drove me back to my hotel.

A large buffet dinner was served, but I was so busy talking that I didn't get much of a chance at it. It was probably just as well, for everything was very highly seasoned with red pepper and I might have succumbed to "Delhi-Belly" even earlier than I did if I'd loaded up on it. I like the food, but my stomach is only used to medium hot curries, not the scorching curries they serve. If you'd like to approximate an

Indian amateurs and radio officials at reception in New Delhi. The late Dr. Sarwate, then Secretary General of the ITU is seated in the center of the front row.



Indian curry, then add two spoons of red pepper for every spoon of curry when you make it. Have you watched Mr. Terrific on a color set?

Taj Mahal

Raju and Karnik (VU2CK), the only Indian amateur I'd managed to talk with from home before the trip, had arranged to go with me the next morning down to Agra, about 150 miles south, to see the Taj Mahal. We were going to go down by train, but they arrived a little late and we decided to take a taxi instead.

Frankly I was no little alarmed at this turn of events. I knew, somehow, that it was the rich American who would pay for this. And the idea of having to pay for a 300 plus mile fourteen hour taxi ride probably upset me as much as any of the food I ate on the trip.

Driving through Delhi is an experience which is hard to describe. There are bicycles by the thousands . . . coming at you, going away, and just crossing the streets. Then there are scooters, motorcycles, pedicabs, motorcycle cabs, taxis, cars, trucks, buses, donkey carts, oxearts, bullock carts, cows, sheep, goats, hand pushed carts, men staggering under immense loads, women with several things balanced on their heads, children about 18" high running back and forth across the street, horses, horse drawn cabs, and water buffalo, all in profusion filling the streets and roads. The cars . . . particularly the taxis . . . drive through this mass as fast as they can, honking their horns steadily . . . though I saw no sign of anyone paying the slightest attention to horns. Everything is missed by inches. I would expect the man on the Lambretta, with his wife and three children hanging on behind him, to make an effort not to be

run down. I was wrong. We drove through these crowds, shoving people and animals out of our way as we drove.

Along about half way to Agra the driver stopped for his lunch while the three of us sat in the taxi and waited for him. I passed the time by taking pictures of a snake charmer and his cobra, a trained bear on a leash, and a fellow with an eight foot python.

We arrived in Agra about 10:30 and, after trying to find Les King, VU2AK, who happened to be out of town that day, we stopped for breakfast. The omelet, coffee, toast and pastries all around were my treat . . . \$1.30 for the three of us complete. Raju and Karnik complained about the prices . . . twice as much as Delhi . . . gouging the tourists. It was a good meal and I felt great in spite of the 100° temperature.

We stopped for a minute while Raju got a wad of betel nut to chew. He thoughtfully got one for me too. They take a large leaf and paint it with a brown goo, drop a few chunks of betel nut in it, sprinkle some ground spices on it, fold it up and then you pop this mouthful into your mouth and chew. It tasted medicinal, but I gamely chewed away at it. You can spot betel nut chewers by their permanently red lips and mouth. It is supposed to help your digestion. It didn't help mine.

Just a few minutes from town, we pulled up in front of a large palace type of building and got out of the taxi. I just made it to a nearby hedge with the mouth full of betel nut . . . whooey! The combination of the long trip, the oppressive heat and the betel nut had me dizzy and reeling, but I grabbed my wide angle and telephoto cameras and went through the archway, fighting off the hordes of people pleading and begging to guide me or sell me some-

thing.

There, in front of me, was the Taj Mahal . . . sure enough. Just like all the pictures. In a daze I took pictures of the Taj, Raju, and Karnik . . . we took off our shoes and walked up to the pure white building . . . blinding in this sun. Translucent marble with millions of intricate designs carved and set with colored stones. The dome inside is so perfect that you can hear an echo for over five seconds. The building took 18 years to finish and apparently kept the country so busy that they didn't have time for wars. It was built 700 years ago.

In spite of frequent infusions of orange soda, ice cream and pineapple juice, I was just able to keep going in the heat. A half mile away we went through the Red Fort, a huge palace where the king used to live and run the country. Then came another palace, about twenty miles away, built by the father of the chap who built the Taj Mahal. He made a little mistake. When they got through building the palace there, they discovered that there was no water locally and it all had to be brought in. So they eventually gave up and built the Red Fort near the river, and used that.

We stopped in town for dinner. The curried food . . . and everything except the milkshake was curried . . . tasted good, but hit my stomach like live coals and burned its way on down during the interminable drive back to Delhi. The milkshake was like nothing I've ever tasted before . . . buffalo milk, I think, sweet and cold . . . I didn't complain.

Along most of the road between Delhi and Agra I noticed a ditch about the width of the road, filled with water. What is? That's where they got the dirt for the road. Simple solution.

During most of the trip back, I added to my discomfort by trying to figure out how much this little taxi ride was going to cost me. Lordy, imagine what something like that would cost in America! We pulled up in front of the hotel a little after eight o'clock and I got the word . . . 140 rupees. Whew! That's about \$14. Over 300 miles plus fourteen hours for the driver for a total bill of \$14. With great relief I staggered to my room and to bed for the night.

Old Delhi

At 5:30 the next morning, I was on my way to see Raju and try to keep a schedule

with Jim Fisk back at my home station. Raju had written the instructions for a taxi driver to find his place, but I worried. I'd been through this bit before where a driver looks at instructions, drives off confidently and then ends up driving all over the place, lost. All on the meter, of course. Then they talk excitedly to me in their own language and eventually, several dollars later, return me to my hotel to look for a smarter taxi driver.

I lucked out this particular morning and found Raju's apartment quickly. Only YV's coming through. Not a whisper from the states. Raju's wife served an Indian breakfast . . . something like a curried potato salad with Indian bread . . . tasted great, but don't they get a lot of heart burn from all that pepper in every meal? My lips burned and I drank quite a bit of water and coffee. Good coffee. Obviously the band isn't going to open this morning.

Along about eight we took a taxi downtown and dropped in on Dar VU2BX. Dar had an SX-28 and a very old, low powered, AM transmitter. No wonder we don't hear him in the U.S. Amar VU2CZ arrived, and we all went out to see old Delhi in Dar's car. As we got into the older section of town, the shops were mere stalls and jumbled all over one another . . . some in the street, some on the sidewalk, and some back a ways. People everywhere, Christmas in Macy's. We drove right through the mass of people, animals and wheeled things . . . I said how about stopping so I can take some pictures of this . . . sure, anywhere you like, said Dar, driving madly on . . . STOP, right here . . . oh, we can't here . . . and on he went. I think I screamed.

Dar stopped in surprise and I jumped out before he could sort out his gears and get going again. I snapped pictures in all directions, running through a whole roll of film before the heat (and breakfast) got to me. Aha, just ahead was a cold drink stand with Gold Spot orange soda . . . boy, do I need some of that! I offered to buy them all a bottle . . . it costs about 3c a bottle. oh, no, come over here. No, I want an orange . . . no, come this way. Reluctantly I let myself be dragged away from the cold drinks and into a small dark booth where there were piles of very old World War II surplus radio gear, most of it in terrible shape. We were in an Indian surplus store.

Dar said something to the proprietor and he went out for a minute and came back with four bottles of Gold Spot. The first went down in one gulp. The second I drank slowly, beginning to perk up a bit. Raju was looking for some small resistors and the shop keeper was looking through old candy boxes of junk trying to find the right values. The parts looked as if they had been pulled from a third hand radio. With old carbon resistors at about \$2 each, comparitively, the hams can't afford to buy many parts.

Back in the car, we lurched along passing one remarkable sight after another. I sure would like to take a picture of that. Dar drove on. Can I get a picture of that? Sure, we'll be back later and stop. I screamed again. When they got me calmed down, we parked and set out on foot, my cameras snapping.

Weakened, the heat got to me quicker this time and I began to wilt. Dar and Raju climbed a long long staircase to a mosque . . . tremendous place. They wanted me to take off my shoes and go in . . . 1 could see acres of hot burning stones ahead and the blazing sun overhead. I leaned against the wall and said absolutely no . . . no more mosques. They lamented that all foreigners wanted to see was the Taj Mahal and all other mosques were ignored. I agreed . . . now let's get back to the car; I'm beginning to reel.

We went around a circle and found another surplus store with the parts spread out over the sidewalk in boxes. More incredible junk by our standards. Raju kicked at it a bit, to show his contempt, before asking the price. He had to send out for some orange sodas too . . . I gulped down a couple more, coming back to life just a bit. The proprietor, anxious to set up a good atmosphere for business, passed out some little seeds to Dar and Raju . . . Dar passed along a couple to me. After the betel nut experience I was wary. Sure enough, ugh! I waited for them to turn away for a minute so I could get rid of them. After several painful minutes I deposited them behind a BC-375 tuning unit, and spitting bright yellow, I started looking over the gear for sale. The storekeeper was not out of tricks yet. He whipped out a handful of seeds for Raju and Dar. They tried everything they could to get me to try them . . . what

are they? Anise. No thanks, I know anise, not now. Our host was frustrated. He next brought out some tiny foil pellets . . . here chew one of these. I gave up and tried it. What is it? Cardamom, the same as you had before. Yep, that's what it was alright. Ptooey. They led an almost unconscious Wayne back to the car.

After a little nap, a shower, and an Indian lunch at the hotel, Dar and Amar picked me up and drove me to the Ministry of Communications to talk with the Secretary to the Ministry. Colonel Rai was there with Lal. We all went in and talked with the Secretary for about a half hour. I explained what I had in mind . . . the gathering of radio parts and equipment in the U.S. for shipment to India for the amateurs and amateur radio clubs. I explained the importance of amateur radio to the development of India and he was quite enthusiastic and anxious to get the project started. I said that as soon as I had a letter from him making it official that the equipment could be imported duty free, I would start work on my end. I felt that if we in the U.S. were going to help out by donating gear, the least India could do was allow it to enter the country without charging their usual prohibitive duty.

During the afternoon I wandered through some of the tourist stores near the hotel and bought a few knick knacks.

That evening I had dinner with the ARSI officers. Most of the evening was spent with the fellows arguing with Dar, so I didn't get a word in edgewise. He had strong opinions on everything brought up and didn't seem to feel any need for facts or reason to support his arguments.

In the paper it was mentioned that one man was making 75 rupees a month after 15 years on the job. Another was making 125 rupees after 25 years. Karnik is doing very well at 1000 . . . upper class. A rupee, remember, is worth about ten cents.

VU2JM

The next morning my hotel phone started ringing early and by 9 I had a morning planned with Raju, lunch with Minoo Patel VU2JM and dinner with Rai. Raju and I went shopping. I bought some spotted mink gloves for \$2.50 a pair . . . and leopard gloves were \$5. Things were so low priced that it was difficult to hold back.

Minoo picked me up for lunch in his Mercedes 180. We ate at the Imperial Hotel, very impressive, and then on to his office for a cup of tea and a little business. Minoo is a brigadier and is treated with considerable respect and pomp. Then on to his house, a beautifully modern one, complete with charming wife and Coca-Cola in ice. I sat down at his SX-111 and Johnson Valiant for a few short contacts. I worked a couple VK2's and then 9N1MM called in to say hello. I told Father Moran that I would be on schedule, arriving tomorrow afternoon.

That evening I had dinner with Rai and his wife. It was a delicious Indian meal. We talked over the problems involved with bringing in ham gear and Rai suggested that the Institute of Telecommunications Engineers, the Indian counterpart of our IEEE, act as the importing agent and take care of distributing it to the amateurs and clubs. He said he had an OK on this from the Secretary of the Institute. That sounded like a fine idea and it would get around the problems they are having in the ARSI. It is a lot better to have a third agency in charge of distribution.

Between the heat and the curry, Delhi did wear me down a lot. Delhi-belly set in. Fortunately my flight to Nepal was delayed a day and I had a chance to rest up and recuperate before facing Father Moran and Katmandu.

It is now almost a year later and I'm still waiting for that letter from Jain, the Secretary of the Ministry of Communications. I did get a call from the Indian Embassy in Washington along in January, but nothing more since then. Perhaps I'm wrong in this, but I feel that they should make some sort of effort to be helped.

Next month . . . the mountains of Nepal.

Montreal

Despite the fact that I am about as popular with the officials at an ARRL convention as a case of the plague, I did consider attending the recent National at Expo. The basic problem that I present is that the League wants to keep a lot of things secret and I insist on spilling the beans. It does not make me popular with them.

Lin, my new wife, and I drove up to Montreal for the Mensa Annual Gathering, figuring that we might stay on for the ARRL deal the following weekend. We were dismayed to find ourselves living in a small hastily constructed box assigned by LogExpo

at \$22 per night. We drove on to Expo and found the signs took us to a \$2 parking lot plus \$2 more for a boat ride to Expo itself across the river from the parking lot. Then add in \$5 for the two Expo "passports" and you have a basic bill of \$31 a day plus meals, rides and gizmos that the XYL buys at the hundreds of little stores spread all through Expo. We stopped off at a little Austrian restaurant and had a simple lunch . . . \$10. I figure Expo cost us about \$70 a day with everything.

Now \$70 a day isn't too bad . . . if it is for one day. But if this goes on for a week . . .! Some of Expo is good fun . . . a lot of it is a dreadful bore. The lines, sometimes hours long, kept me out of most of the better exhibits. By the third day we figured that we had seen all that we could see without long waits and, remembering the \$70, drove back to Peterborough and cancelled any thoughts we had of staying on for the ARRL convention.

Suggestions: after a while you begin to get the swing of Montreal. You can avoid the LogExpo system by driving into Montreal and looking for signs in windows of homes that take roomers. This costs less than half and usually includes a nice breakfast. Then you can take the Metro to Expo from town and not have to drive in, as we did, from a suburban plywood box development. Expo tickets come as low as \$1.50 each if you shop around. I can see where a couple bound on economy could get by for as little as \$25 a day complete. This would mean lunches of hot dogs or buffalo burgers, to be sure. And not too many rides in the amusement area.

By the way, if you do visit Expo, stop in at the ham shack over in La Ronde and put VE2XPO on the air for an hour or so while your feet are recovering. I made a few contacts on twenty, but it cost me plenty. Lin went out and found a handbag at the Morrocan boutique which I might have steered her by if I had been with her instead of talking.

Sorry if I missed you at the convention, but we're going to have to have a whole lot more subscribers to 73 before I can hack that \$70 a day jazz.

More DXCC Deletions

In the July issue of 73 I reported on the hassle between Don Miller and the ARRL.

The latest bulletin is dated July 6th and it deletes credit for working Miller at St.

Peter and Paul's Rocks (PYØXA), Chagos (VO9AA/C),and Heard Island (VK2ADY/Ø). The League claims it has not received "reasonable documentation concerning the manner in which travel was accomplished" for the first two, and that there is a question of authorization by the Australian government on the third. They go on to define what they expect in the way of documentation . . . "a running log showing arrival and departure times at each port and stopping point, name or number of aircraft or vessels employed, and receipts for transportation and lodging."

There is a great bitterness spreading around the world as a result of this latest announcement. Thousands of amateurs spent a lot of time and effort to snag Miller at the five spots the ARRL has so far discredited retroactively . . . no, make that seven, for we can't completely forget the Ebon Atoll and Cormoran Reef DXpeditions that ARRL gave credit for at first and then later cancelled.

The first serious question of determining whether a station was really situated exactly where he said he was came up over ten years ago. There was no secret about this at the time. One fellow signed the calls of several countries he may not have actually visited. I discussed this problem with League staff and know that they were well aware of it.

It was not until Miller had the audacity to refuse to contact some of the top DXCC honor stations that ARRL swung into action. The first happened not long before credit was retracted for Ebon and Cormoran. Miller continued to avoid operators whom he considered were operating contrary to the ARRL DX operating code and the result has been the distressing mess I reported in July.

The League should, when the problem first came up, have established guidelines for DXpeditions to be credited for DXCC. This would have been a simple matter and would have avoided the further complications.

All this is not meant to imply that we do not have any reservations about some of Don's expeditions. To the contrary, we have some very serious doubts that we would like to have dispelled.

Burma

On September 22, 1965 I contacted Don as XZ2TZ in Burma. I have a QSL for this contact. This was quite a coup because the

stations in Burma had been off the air for about three years at this time and there didn't seem to be any possibility for them to get back on again. I didn't know how Don managed to get into this country or how he was able to get permission to operate when the local amateurs were not. He was there, so I knew he had succeeded. I thought nothing more about it.

Then came my own visit to Burma one year later in September 1966. My suspicions were aroused when I found out how difficult it was to get into the country. They did not diminish when I found that the country was now a military state under strong influence of the Chinese, as I will report when I tell you the full story of my incredible visit to Burma in my editorial in a month or so.

You can be sure that I asked a lot of questions when I got in touch with local amateurs. Not one had heard of Don Miller being in Burma. Not one believed that he could have managed to bring in any radio equipment or gotten permission to operate it. In a small country like Burma they felt sure that they would have heard all about anything like that.

Don's story to me was that he and Chuck had been mistaken for CIA men and that Burma had rolled out the red carpet for them. When I suggested this to a man from the British embassy, he laughed and said that no CIA man would ever be allowed to get off a plane in the country.

Frankly, I left Burma with a strong suspicion that Don had not actually been there during the XZ2TZ expedition. This would be simple to verify by a photostat of the page in Don's passport where the dates that he entered and left must be indicated. I, for one, would like to see this positive proof that he actually was in Burma during the expedition period.

My discussions in Bangkok raised similar questions about K7LMU/HS. The active amateur whom I talked with there said that local operators had not been able to hear Don and Chuck during this operation.

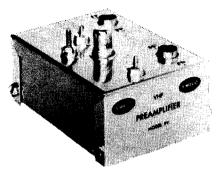
St. Peter and Paul Rocks

Many of the questions that come up about the Miller expeditions involve circumstantial evidence. For instance on the PYØXA trip we have reports from Brazil that the station seemed to be in the direction of Guyana instead of almost 90° away, from the Rocks.



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Then there is the question of how a 58 foot power boat was able to go for almost 4000 miles without refueling, from Cayenne to the Rocks and back.

Heard Island

Two problems have cropped up with this one. First there is the matter of the lack of authorization to land on Heard and then there is a bit of doubt in my mind as to where Don actually was during this expedition. You see, I have it second hand, but from a good source, that Don was positively in Vancouver, B.C. the day before the operation went on the air from "Heard." Since this is the antipodes to Heard the beam headings could be OK for many stations. But it is difficult for me to understand how Don was able to move 12,000 miles in one day to a very remote island not far from Antarctica.

Others, Too

Similarly strong circumstantial evidence raises questions about Niue Island, where locals insist that no expedition has operated in recent years. And then there is Minerva Reef, 1M4A, where Don operated for 48 hours of the DX contest. The problem here is that, as far as I know, this reef is under water, three feet of water, except during extreme low tide. The only identifiable landmark on the reef is the hulk of an old fishing boat. This, strangely, was missing from Don's pictures of the reef.

We've all watched too many Perry Mason mysteries to convict someone on circumstantial evidence, no matter how incriminating. But I do think that we are due incontrovertible proof that the countries which are supposed to count for WTW have been the actual sites of the operations. I think ARRL is due the same for credit for their DXCC. And aren't the fellows who made his trip possible by donating thousands of dollars also due a complete and well documented report on the operations?

Rather than continue this battle between Miller and the ARRL where the League makes an accusation and Miller then refutes it, let's clear up all this nonsense once and for all with a detailed and officially documented report on the whole expedition.

. . . Wayne

NEW BOOKS

Single Sideband: Theory and Practice

Most amateurs operating on the high-frequency bands today are using single sideband; on VHF and UHF its use is increasing all the time. In addition, the majority of commercial communications stations have adopted ssb for maximum use of the usable spectrum. This new book by Harry Hooton W6TYH is an essential text for those interested in single sideband communications and equipment.

"Single Sideband: Theory and Practice" covers the origin of single sideband in the early days, the derivation of ssb signals, carrier suppression techniques, sideband selection, carrier generators, speech amplifiers and filters, ssb generators, balanced mixers and converters, low-power ssb transmitters, linear power amplifiers, ssb communications receivers, transceivers, tests, and measurements. Each of the sections is well illustrated with practical circuits and emphasizes basic principles and circuitry rather than mathematics. If you are having trouble understanding the fundamentals of ssb, W6TYH's presentation is straight forward and easy to understand.

The sections on the design, construction, and adjustment of linear amplifiers contain enough information so that any amateur can build his own equipment. In addition to the illustrations contained in the text, there is a foldout section in the rear which contains detailed schematics of many of the popular amateur ssb receivers, transmitters and transceievers. If you operate single sideband and/or want to know more about it, this is a very useful volume. \$6.95 from your local electronics distributor or write to Editors and Engineers, Ltd., New Augusta, Indiana 46268.

Ten Minute Test Techniques

How many times have you had to return your rig to the factory for repair? Or turned the household TV or radio over to a serviceman? If you have, you should have a copy of Elmer Carlson's "Ten Minute Test Techniques" in your shop. This new equipment servicing guide approaches electronic trouble-shooting from a new and unique angle—that

every circuit is essentially an amplifier or rectifier. With this fact in mind, and some common sense, even the most complex electronic equipment can be easily tested and analyzed with basic test equipment and simple servicing procedures.

The volume is profusely illustrated and describes several specific methods which can be used to analyze either tube or transistor circuits in all types of electronic equipment, including power supplies, amplifiers, oscillators and transmitters. Step-by-step test techniques are outlined which may be used for localizing troubles and pinpointing defective components without delving into involved theoretical discussions.

If you are ever required to fix that receiver, transmitter or transceiver, this book can save you a lot of sweat and tears. More than 25 years of experience have gone into it and many time and temper savers are included, with practical hints for solving troubles fast and eliminating repeat failures. \$6.95 from your local book store or write to TAB Books, Drawer D, 18 Frederick Road, Thurmont, Maryland 21788.

Slide Rule in Electronics

If you work with electronic circuits, design them or analyze them, the rapid, accurate calculations available with a slide rule simplify matters considerably and save a lot of time. It has yet to be surpassed, even by a computer, in terms of weight, size, speed and variety of calculations and simplicity of operation. The slide rule is especially useful to the amateur and technician because most of the ordinary electronics math encountered can be easily calculated.

"Slide Rule in Electronics", by Don Carper, teaches you how to use the slide rule for making quick, accurate calculations in electronics. The book is divided into twelve lessons covering multiplication, placing the decimal point, reciprocals, squares, cubes and roots, ratios and proportions, folded scales, trig functions, and logarithms. Each lesson, in turn, is divided into sections containing practice problems and exercises. It shows you how to calculate resistance, reactance, impedance, current and voltage relations, frequencies, phase angles, and many other quantities.

\$4.25 from your local electronics parts store, or write to Howard W. Sams & Company, Inc., 4300 West 62nd Street, Indianapolis, Indiana 46206.

Transistor Substitution Handbook

If you're using transistors in your projects these days, and are trying out various new circuits, you have undoubtedly run into the problem of what transistor to use when the one specified is not available. This new book from Howard W. Sams & Company was compiled by a computer and is one of the most complete listings of transistor substitutes available. The substitutions were selected by comparing the electrical and physical parameters of each transistor with a computer.

For the past several years about 1,000 new transistor types have been introduced each year. In some cases specific types are no longer manufactured and it is impossible to obtain an exact replacement. Furthermore, because there are several type-numbering systems in use besides the stand and 2N- system, it is sometimes difficult to determine whether a different unit will serve the purpose.

In addition to the computer selected substitutions, this handbook lists all the majorline, general-replacement type transistors in accordance with the manufacturer recommendations. Information also includes the manufacturers, NPN and PNP polarities, germanium and silicon types, and basing diagram styles. If you work with transistors, you shouldn't be without this book. \$1.75 from your electronics parts distributor or write to Howard W. Sams & Company, Inc., 4300 West 62nd Street, Indianapolis, Indiana 46206.

MF/HF Communications Antennas

Actually, the entire title of this government publication is "DCA (Defense Communications Agency) Engineering-Installation Standards Manual, Addendum No. 1, MF/HF Communications Antennas"! Like many other publications from the Government Printing Office, this jewel has an awful lot of information between its covers for a very economical price. The subject of course is antennas, their characteristics, design, siting, testing, and installation. In addition, there is information on electromagnetic theory, propagation and basic antenna theory.

If you want to know what antenna you should use for a given purpose, this book compares size, directivity, frequency range and cost. When you have decided what antenna you want to use, it will tell you how to design it. Complete design details are

given for rhombics, log-periodics, terminatedvees, yagis, dipoles and sloping antennas as well as compromise and compact designs. The field-testing section is particularly interesting, and covers tuning and matching devices and procedures, field strength measurements, VSWR and ground resistance. The installation section covers tower erection, guying and basic installation requirements. For the DX men there is a simple method of finding great circle distances and bearings. A best buy for antenna men at \$2.30 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Order DCA 330-175-1, Addendum No. 1.

New Sams Publications

Howard W. Sams has several new publications this month that are useful to the ham. First of all, "Slide Rule in Electronics" shows how to use the slip-stick for making quick, accurate calculations in electronics math. It tells how to calculate resistance, reactance, impedance, current and voltage relations, frequency, phase angles and many other quantities. Price is \$4.25.

For the beginner not acquainted with electricity or electronics, "Basic Electricity and an Introduction to Electronics" is an excellent starter text. It is written in a simple, easy-to-understand style, supplemented by liberal use of diagrams and illustrations and presents the basic fundamentals so simply and clearly that the subject does not seem difficult at all. This book covers the fundamentals of electricity and magnetism and follows up with coverage of electronic circuits, transistors and other semiconductors and television and industrial electronics. Price \$3.95.

The stereo buff and home fix-it man will be interested in "101 Ways to Use Your Hi-Fi Test Equipment". This book answers the basic questions most often asked about hi-fi instruments and places the emphasis on basic audio tests of hi-fi amplifiers and associated equipment. It covers the use of harmonic-distortion meters, audio wattmeters, tone-burst generators, and fm stereo-multiplex generators. Practical information as well as precautions and required equipment and connections are given for each test. Price \$2.95.

Each of these books may be obtained from your electronics distributor, or direct from the publisher, Howard W. Sams and Company, Inc., 4300 West 62nd Street, Indianapolis, Indiana 46206.

Can The Patient Be Cured?

In the field of medicine there are dreaded words like cancer and arteriosclerosis. I am not alluding to medical problems. My patient is Ham Radio as it has existed these past fifty years. My client has the middle age bulge. He is apathetic and is so engrossed in his own little world that he cannot see the larger problems that are ready to overtake him. He won't face the fact that he is a sick man, and not being able to admit to a deficiency, you can hardly expect him to do anything about it. He is like the chain smoker who has been told about lung cancer and emphysema, but because it hasn't caught him yet, he continues his four packs a day.

Ham Radio is sick. You don't have to be a trained diagnostician to observe the symptoms. But to those of you who haven't thought much about it, let me enumerate some of the more obvious signs.

A. A falling off of new hams.

B. The reduction of sales outlets catering to hams.

C. The relative lack of advertising revenues in the ham magazines and consequent financial ills of all three publishers.

D. The statistics of those recording the vital facts on our gross ham business.

E. The obvious reduction in respect afforded amateurs by our government.

If these are the signs of illness—what can the reasons for this sickness be? In my judgment there are at least five areas that collectively have caused our plight.

 The announced need of incentive licensing without the reasonably quick surgery required. The FCC has taken altogether too long to do what should have been done.

 The abiding concern most of us have had with respect to the Viet Nam war and the possibility that escalation would require a congressional declaration of war with the attendant prospect of our loss of ham operating rights.

3. The existence of C.B. radio. This simple way to "ham" without code or technical examination has taken the largest number of would-be hams away from our ranks, and with loose FCC enforcement of C.B. rules, has given a vent to those with an itch to communicate.

4. The science of our art has gone beyond our average ability to comprehend, and we have therefore not been able to keep up with the latest in SSB techniques, in synthesis, in solid state circuits, or in mathematical filter design. What we understood very well in 1947 has become an enigma in 1967.

5. Because the sources of supply have largely disappeared, we as individuals can no longer build as easily as we once did, and therefore we place more reliance on store-bought preassembled rigs. Because we didn't build it, we don't really know the piece.

6. As a nation, more of us exist, with less physical space on which to erect antennas. More of us are moving than ever before, or are living in mobile homes. Certainly less chance to do things the way we used to. And as a corollary, we are more prone to give in to rather than fight TVI, for obviously there are more TV sets, more TV stations, more rabbit ears than there used to be. We are not as determined as we once were, probably because there are so many other things to do! Ham Radio has gradually lost its pre-eminent position in the community which it once had for disaster relief and emergencies. Nowadays competing services are better organized to step in and take over. Civil Defense organizations have matured, professional communication outfits exist such as police, public utility and fire departments with far more facilities than yesteryear, and many of these "pros" don't want us hams monkeying around.

These are the symptoms of our illness, but many other threats exist too. For example, the increased number of newly arrived nations will all want to control their own spectrum, to assert their own ideology with their short wave broadcasting stations. For example, there is a larger need for business frequencies, for space for millions of CB'ers, and for a larger government and military requirement. What this means is that despite technical progress, a larger demand on our frequencies will inevitably be made.

SHOULD WE ROLL OVER AND DIE?

Emphatically NOT! Ham Radio is still king of all hobbies. The nation with a large ham population is still really the best prepared country. The Near East scrap was interesting. Israel, with 2,700,000 people, has nearly 400 hams. The U.A.R. and Syria and Jordan, with over 10 times the population, have between them scarcely 20 hams.

Surely this lesson is not going to be lost, but as hams, can't we see that the Prime Ministers, or other heads of state, obtain copies of the foreign Call Book and visualize this lesson while it is still fresh?

There are many other things to do. For example, why can't we beat incentive licensing to the punch and up our license grade before we have to? Wouldn't this prove that we care, to the FCC?

For example, why can't we infiltrate the ranks of CB radio, join their clubs and show them the difference between 5 watts and 500 watts, the difference between legal and illegal QSO's?

For example, why can't we foster more high school radio clubs, more church radio clubs, more Boy Scout radio groups? Why not let every ham club push for new beginners by offering classes and suitable incentives within our existing ham organizations?

For example, why can't the kit manufacturers, instead of just telling us to solder 3" of red wire betwen points A and B, explain their product's philosophy and circuit details in a better educational manner? Too many kits built, not enough knowledge gained in the process.

For example, why can't the Electronic Industry Association create a committee of Amateur Products manufacturers, said committee to study our problems and the attendant lack of motivation by those handling the sale of this material, and over a period of time, implement their suggestions as only the united strength of the EIA can do?

For example, if Ham Radio is the reservoir of trained operators that we are supposed to be, how about enabling legislation in the Congress that would give us tax exemption on the money spent for ham radio in each year? This is worth looking into. And, in a lesser vein, how about convincing your respective state governments that sales taxes should be levied on the difference value of your purchase, when you trade in your old gear? Here is discrimination that has a telling effect against us hams. We don't know how to lobby for useful gains—license plates for our cars, yes, but cash in our pockets, no.

For example, why not resolve to build something this year, even if it is only a phone patch or an RF monitor? Rolling your own does make it taste better. And, as Doug DeMaw used to say, "we learn by doing."

For example, why can't we make a determined effort to utilize more of our unoccupied 2 and 6 meter bands, before they are gone? Possession is supposed to be 9/10ths of the law.

For example, why can't more authors and more radio magazines concentrate on showing us how to knock down front end overload by enabling us to make our own filters? And why not special emphasis on tact and diplomacy in handling TVI problems? Must we always be Mr. Meek?

For example, how many revitalizing ham radio club activities? No imagination equals no attendance equals no club. In the same breath, let's have more small ham fests. These very large ones neither satisfy the visitor, the exhibitor, or the sponsoring group, and oh, my feet!

For example, let's all join the ARRL and support their cause, which is really our battle. Even though you may dislike them, or disagree with some of the things that are done—(we're not all perfect, you know)—your membership and support is the most logical way through which you can effect any change, not by leaving them and ranting from outside.

For example, as hams, why can't more of us join MARS—either Navy, Army, or Air Force, and prove to our government in the most telling of all ways, that our ham radio is a precious right, for both pleasure and public good, rather than something we take for granted like social security and medicare. God knows we've depended too much already on government and not done enough for ourselves!

Gee whiz, fellows—look in the mirror now. Is your face clean?

Herbert W. Gordon WIIBY P.S. Don't misunderstand me. I'm no angel! I am in the business of selling exclusively to hams. It's to my advantage to see Ham Radio healthy and pink—not with a white tongue the way it is today.

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The View from Here (Continued from page 2)

about splattering and misadjusted SSB transmitters, but in many cases the trouble lies right in the complainer's own receiver. If he would put an attenuation pad in the transmission line so the front end wasn't overloaded, the spurious splatter signals would miraculously disappear.

Since single sideband is so much more efficient than AM, a little bit goes a long way, and when conditions are good, receiver overload can be a problem. So, before you accuse another operator of splattering or broad signals, you had better check his signal on a scope—after turning off the AVC in your receiver.

If you have any other reasons why AM should not be removed from the ham bands up to ten meters, I'd be very glad to hear from you. But before you write, check your facts by reading the references given below.

Jim Fisk W1DTY

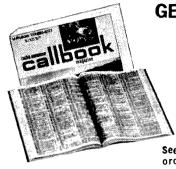
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Letters

AM—Sideband Feud

Dear 73.

I just finished reading your "View From Here" in the June issue of CQ. (Sic) Here is my view from Southern California. I think you have expressed your personal opinion without giving much thought to the other side of the page.

I retired about 8 years ago at the age of 70, and for the next four years I spent the most lonely and

purposeless life imaginable.

Then a Nephew suggested that perhaps amateur radio would be interesting. He gave me an ARC-2 tranceiver and some ARRL books, and after 3½ months of intensive study, I passed the General exam . . and began having the greatest pleasure I had ever experienced,

. . . After a time, I managed to procure a used communications receiver and a Johnson transmitter. SSB equipment was out of my reach. This equipment has brought me more happy hours than I can tell you and has made the life of an old man seem very worth while.

Every day I talk to many hams who have to get along with used AM equipment for financial reasons. If you feel that the bands are unnecessarily crowded.

why not instigate a campaign to educate the SSB operators in the proper operation of their equipment. Any time of the day or night, SSB can be heard splattering over much more of the spectrum than is necessary . . . sometimes as much as 10 kHz.

Have you ever stopped to think that not a single commercial station, fire dept., police dept., or any organization that wants to get a message through

without using phonetics are using SSB?

No one has a SSB rig of the usual 200-300 watts P.E.P. for very long before they want to hook a 2000 watt linear on it and use full power even for a very short-haul QSO. This is totally unnecessary and not in compliance with FCC regulations.

The last paragraph of your editorial about the state of the art is amusing. How many of the SSB operators do you honestly believe are operating in accordance

with the state of the art?

. . . I have been a reader and subscriber of 73 since January 1964 and believe you have the best amateur radio magazine published. I have dropped the other two, but I don't think your editorial was in the best interest of amateur radio.

I have never heard Wayne Green make any such statements.

This has been a very long reply to your View From Here, but I believe it has done me some benefit to get it off my chest. I expect it to receive waste basket filing.

Arthur M. Smith WB6MTI Riverside, California

Well, well, I just received my first subscription copy (June 67) to 73 and low and behold I find in 'The View from Here' advocacy of policy which led me to forsake QST.

Your reference to AM and the reasons for eliminating it in favor of SSB suggests that you are confounding the broad purposes of amateur radio by confining it to rag chewers, traffic handlers, and appliance operators. I agree that the AM stations should not complain of SSB QRM or vice versa. I am convinced however, through my experiences in the

industry, that for the sake of the country and it's technological resources, the ham experimenter is the largest potential contributor. To maintain his interest, the bands must be available without selected restric-

I have a KW of SSB, AM, RTTY and VHF (all home brew) and apply each as the occasion demands.

In 1938 two other stations and my own, were, to my knowledge, the only stations on SSB and we were practically run off the air. How the tides turn!

W. H. Grosselfinger W2ATQ Lloyd Harbor, N. Y.

You've missed one point. There are some of us that simply don't have the price of "a good communications receiver a decade ago." I'm all for SSB, and I'll get it someday, but in the mean time I have a family to support too. Something is better than nothing.

J. Bradley Flippin K6HPR Falls Church, Va.

Dear 73.

Don't you feel a more favorable approach to the situation of AM and SSB would be to shorten the CW band and allocate frequencies for both modes? You know as well as I do that a strong SSB signal will take out a weak one and a large percent of SSB fellows don't have their rigs adjusted properly anyway. AM activity has really increased in the past several weeks . . . Wonder why?

Warren C. Shook LaFayette, Ohio

Dear 73.

Yesterday I received my copy of June issue of 73 Magazine and after reading "The View from Here" by idiot Jim WIDTY I am most ashamed I am a reader of the magazine.

It is my belief that a magazine should not be so narrow minded as to issue such an article against AM transmission when Sideband had better clean it's own doorstep first. They overmodulate and cover from 5 to 10 Kc with heavy linears. There is no courtesy among SB operators as among AM operators. SB at best sounds as though the person was talking with a mouth of hot mush. Not a thing like the clear, understandable reception of AM.

If SB is so great, why don't all broadcasting companies use it?

So I think you should rewrite that article and give AM it's rightful place. I have Drake equipment on SB, and a Johnson Viking II on AM, of which will always be my first love.

Claude H. Keneaster WA5LFL El Paso, Texas

Dear 73.

Are you proposing that AM be outlawed? If so, I think you are making a big mistake. Please clarify your views.

You mention the contribution of amateurs to the state of the art. How, pray tell, does buying an SSB tranceiver, as you suggested, contribute to the state of the art? A CB'er, buying transistorized tranceivers also hastened the development of power transistors for use at 30 megacycles. Was this a contribution to the state of the art? If so, give CB'ers the credit.

. . . It was interesting to learn that AM wasn't compatible with SSB. I hadn't noticed. Some of the

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operators aren't, but that is irrelevant.

If AM (advanced modulation) is outlawed, I shall either move back to CW or go QRT. I can't afford SSB for some time.

My subscription renewal awaits some acceptable explanation for "The View from Here" in June '67 issue. I want to subscribe but I feel that I can't support someone trying to kick me off the air.

Carl "Skip" Roby WB2TCV Corning, New York

Dear 73,

Re your editorial (June '67) . . . your only legitimate reason given for SSB is spectrum clearance, which you promptly discount by suggesting DSB. The rest is mostly invective and high-flown phrases that mean little.

The point is that AM is frequently misused. There are still plenty who allow frequencies over 3 kc to get through the modulator, who run dead carrier, etc. However there are just as many badly adjusted SSB rigs, and properly adjusting an SSB rig, particularly a home-brew one, is tougher than getting good platemodulated AM.

... As to 872 rectifiers, they work good, and don't cut loose on transients, like silicon stacks. They are also cheap if you know where to look.

On VHF, I believe in the dark horse; Future Modulation. There's room for it, and it'll give SSB trouble. Incidentally, I know good AM when I see it. I'm a broadcast engineer.

Joel S. Look W1KCR Claremont, N.H.

Dear 73,

Well the Editorial in June sounds like ARRL, pro RM 499, Docket 15328 or whatever it was.

May I suggest that the SSB operator who runs a kw that is not linear or is driving improperly is causing more QRM than any AM station ever thought of causing.

. . . I too think AM is a little too wide from the standpoint of spectrum space, but you haven't heard an AM station when told he had a problem, not immediately start looking for the cause and cure. Not SSB, no sir, there must be something wrong with your receiver OM and go right on yakking.

Check with an owner of the most popular SSB tranceiver on the market and see how wide some of the signals are.

I don't advocate anything except detering the thought that SSB is superior in practice without specialized receiving equipment. By the way, the other SB and the carrier are transmitted along with the wanted SB, they are at a reduced level however.

Let's keep the story straight in 73 and not resort to Huntoon's (ARRL & Me Too) tactics.

If you really want to be narrow—return to CW.

K. Mulkey

Dear 73,

. . . You say AM is dead, when is the funeral? To save space why don't we scrap SSB also and make everyone use CW. Three signals in space of one SSB! And no quacks!

A. S. Johnson W6EPO El Cajon, Calif.

Dear 73,

Mr. Jim Fisk, W1DTY, may be up on the latest transistor circuits, but he could stand a little bit of education in the stand point of amateur radio today. About his brutal beating of AM as a mode of communications, I couldn't be more in disagreement. Jim may be in love with SSB, so let him love it.

Sure side band is more efficient as a communicating mode, but so what? Consider if you will, the person interested in amateur radio. More than likely, he will obtain an inexpensive receiver without a BFO. So, he gets home, turns on his receiver, which is more often than not, a small transistor portable, and all

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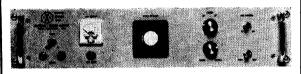
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WE PAY CASH FOR TUBES

Lewispaul Electronics, Inc. 303 West Crescent Avenue Allandale, New Jersey 07401 he hears is something that sounds like monkey chatter. So, having no way to decipher this stuff, he moves away. This is what would happen if AM is outlawed. I will not go so far as to say that if he could understand some of the characters on SSB he would be scared off just as quickly as if he had not been exposed to AM at all.

Don't try to kid me. I've heard several guys after they have been introduced to sideband. They have been changed, and far, far away from better. They go nuts with their power in SSB. These guys find an AM QSO in progress and interfere with it until it ends

Amateur radio is in a downward fall as it is. A certain select group seems to want to bar all new-comers to the hobby and turn the bands into a huge Citizen's Band.

Terry Climer Lebanon, Tenn.

P.S. I'm a Novice and I'm proud of it!

Come on Terry, you're not going to do much operating on the novice bands with a receiver that doesn't have a BFO!

Dear 73,

Page 2 of the June issue has a very repulsive and untrue innuendo, directed at amplitude modulation. It is not Ancient, as you are trying to make your readers believe. It does have many uses, one of which is to introduce speech and music to any continuously generated radio frequency, such as a CW transmitter with 'key down', and also to do likewise to a single or double sideband transmitter with suppressed carrier. Therefore you have contradicted yourself by taking interest in DSB, where amplitude modulation is used, except for the suppression of the carrier. Double-sideband is the same as used by broadcasting stations, and is what I use. The only difference is in whether or not the carrier is present. By using suppressed carrier, and doing a proper job, the receiver has to have added circuitry, to take the place of the carrier frequency which is included in 'unsuppressed' carrier transmission. Otherwise the AM will not, generally, have the fidelity of unsupported carrier operation, and the person on the other end, does not sound the same as when conversing face-to-face.

By your attitude, I must assume that you don't believe in regenerative receivers. Incidentally, they are not obsolete, only the old, inefficient and unnecessarily large parts of such equipment have become obsolete. Spark and arc transmitters are still usable, but the space can be better utilized, and the broadness of transmissions have made the use of such 'early radio aparatus', impractical.

If you are so worried about spectrum space, reflect a moment on 75 and 20 meter phone, and the restriction of class A operators only on those bands. If FCC had different grades of licences, and the higher classes were allowed to operate in more bands than the lower classes, there would be some incentive . . . except for the high cost of getting a license. It used to be FREE.

I am shocked also that any genuine radio amateur would suggest that equipment can be purchased. Instead of being a hobby, it is big business now.

You have also said that AM requires more bandwidth, which is not true when related to the above comment. What isn't compatible is the single-side-band-suppressed-carrier, or in other words, the operation of AM transmitters without carrier, with the AM with—carrier. If suppressed-carrier operation is so wonderful, how come most of the stations need big, high power linear finals? Even SSB-SC does no better when the band goes dead, than conventional AM. They do not have freedom from interference; it inevitable, like death and taxes.

When the "state-of-the-art" becomes the technical standard for the Broadcasting Industry, I'm interested,

and right now that includes double-sideband, low-distortion, high-fidelity, and includes a carrier.

Robert P. Thayer W1PBE

You're only trying to muddy the water-AM in conventional terms infers a DSB signal with carrier. The use of single sideband by the broadcast industry is not practical because of the millions of table top radios that would have to be scrapped. The fidelity of a properly adjusted SSB system can be just as good as an AM one, but not with the 300 to 3000 Hz filters used in communications equipment.

Dear 73,

Well, the new Editor seems to have gotten to a rip-roaring start with his "The View from Here" in the June 67 issue. And here, as he predicted, is one of those cries from an isolated corner.

I take neither side in the AM-SSB matter. I have a low power rig of each type on six meters. However, it seems to me that this little essay doesn't fall too short of what might be called a scathing denunciation of any ham using what is a perfectly legal type of voice transmitter-a type being presently manufactured and sold by reputable companies, and described as construction projects in various publications.

Without questioning any of the advantages of sideband, I suspect that the ownership and use of sideband gear sometimes involves a touch of "status symbol" and social snobbery. It isn't that good. Nothing is.

But worst of all is the statement, "As our technology skyrockets forward, there doesn't seem to be an awful lot the backyard experimenter and amateur can contribute".

I imagine there were those who indulged in similar thinking when radio amateurs found it necessary to abandon spark and master the techniques of tube oscillators and amplifiers and when they found themselves shoved off the high end of the broadcast band into the uncharted short wave regions. Yet, who would you say, pioneered these high frequencies and later VHF and made them work? Maybe RCA? Seems to me there's been some pretty damned spectacular backyard skyrocketing going on. And still is.

And so, I take it, 73 editorial policy in this instance would recommend that the ham content himself with his store-bought appliance gear and leave the thinking to the manufacturers. Now what kind of a ham would that be?

Alden Fowler WA9KHM Greensburg, Ind.

Very few hams are actually doing any pioneering work these days—a few yes, but not the number that were twenty or thirty years ago. How many hams have tried the laser, frequency synthesis, phase-lock loops, masers, parametric amplifiers and other such esoteric doodads? For that matter, how many hams could get through the Proceedings of the IRE these days and understand what they read?

Dear 73.

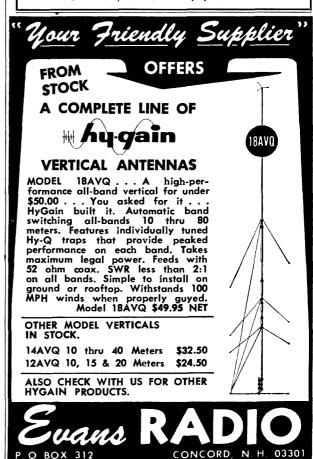
. . . It appears that you have taken an extremely "anti-AM" stand. Let us look more closely at the arguments you proposed. You say, "Everyone else has gone to more efficient and compatible sideband". True, a lot of amateurs have indeed gone to sideband, but they were literally forced to. They had SSB jammed down their throats whether they liked it or not. If one examines sideband from it's early beginning we see that in the late thirties and forties sideband was developed. It didn't catch on partly because of the real expensive equipment needed, partly because of WWII and mostly because there was no manufacturer building and pushing commercial ready built sideband equipment. Then came the fifty's when SSB began to catch on. It caught on because the manufacturers saw a gold mine in it. The manufacturers put on one of the most extensive advertising campaigns ever seen . . . The manufacturers are the real group responsible for the growth of SSB and not the tech-

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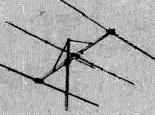
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The DXERS MAGAZINE c/e W4 BPD

Route I, Box 161-A, Cordova, S.C., U.S.A. nical advantages of SSB or the dedication of any individual SSBer.

"Maximum utilization of the bands available" can and will include the use of AM. Is the SSB equipment so poorly made and designed that it can not reject the carrier? If so, then there is a drastic need for improving the SSB equipment and not for forcing or outlawing the AMer off the air.

. . . As far as AM transmitters being "ineffective" I don't think so. . . . Any high level plate modulated AM transmitter can come within a few dB of a SSB transmitter. However you cannot compare a screen modulated or grid modulated transmitter with SSB. There is no comparison. SSB will win every time. When an ultra-modulated AM transmitter is used it can beat an SSB transmitter when both run the same rf power input . . on ultra-modulated AM we can modulate over 100% with little distortion or splattering. We could modulate 300%. This would give us 4500 watts of audio in the sidebands, which is perfectly legal. Ultra-modulated AM beats SSB all to heck,

... AM is indeed compatible. True it is not compatible with SSB but neither is SSB compatible with AM. SSB hasn't done much for the "state of the art" either. A well designed AM rig is efficient and it is very effective.

If ever AM should be discontinued it should be done by consent of only the AM operators. The editor used the word "eliminated" which is a rather ominous and threatening word. The choice of that word was a big mistake. It will solidify the AM'ers and not destroy them. AM will be around for a long time to come, and I will be operating it.

Ronald Zurawski WA8FVD Menominee, Mich.

You'd better take another look at the textbooks— AM is not as efficient nor as effective as sideband, ultra-modulation or not.

Dear 73,

Read your article from here to now. Partly I'll agree with you. I am an old timer who returned to the ranks of ham radio a little over two years ago as a Tech. I used to be W8BZT in the 20's, but let my ticket get away from me. I decided to return, failed the code twice and was ready to give up when the FCC officer suggested that I get the Tech., so I did.

I have been having a lot of fun on 50 MHz but one thing bugs me. If you want to get on the low bands, you must have a kW SSB or you don't make many contacts.

We are not hams anymore but appliance operators. In the old days, you had to build your own gear, antennas, and all. Now days, 80% of the new comers don't know how to build anything. All they need is money. Building is part of the fun and I still do some but I doubt if I could build a SSB rig and make it work.

. . . I would like to see the Techs get to use 80, 40, and 15 meters for CW. Maybe then there would be more chance to get a general. Maybe I'm getting old, but I think a lot of the fun has been taken out of ham radio by commercial building of ham gear. When a hobby begins to cost too much money, it ceases to be a hobby and becomes a burden. There may be a lot of hams that won't agree with me, but most of the old timers will. Ham radio isn't what it used to be. I know as I started out on the 200 meter band in 1923.

Keep up the good work. Maybe ham radio will come back,

G. M. Cooley WA4JYR Dunedin, Florida

I agree, hams should do more building. And, if you can build a communications receiver, you can build a sideband transmitter.

Bouquets and Such . . .

Dear 73.

. . This past year I have been taking 73, QST and CQ, however, I think 73 is the only one of the three worth the subscription fee. I have built several projects from your very fine construction articles and have been well pleased with all of them. Keep up the fine work and 73 to all at 73.

Roy Hook WN8UHB

Dear 73.

I have been reading 73 regularly for a year and it seems that your magazine is getting better every time. The May issue on Quads was very good, and the toroid article in June just fabulous.

I noticed in an ad for the Davco transistorized receiver that your report on this receiver came out almost a year before the report in CQ and almost a year and a half before the report in QST, so you are absolutely right when you say your articles are up-to-date.

I just thought I'd say thanks for a job very well done and keep up the excellent work!

Bob Zulinski WA8MAN Berkley, Mich.

Dear 73.

The March issue of 73 was tremendous!! I would like to see you have an article on a transistorized tranceiver (80 - 6 meter, SSB - CW) or separate transmitter/receiver, using FETs, Also, how about a column for the beginning ham (simple antenna matches, etc.). Anyway, when I saw the cover on my last issue, I pushed the panic button and here is my five bucks for another year of 73.

John Ray WB4BFS Athens, Tennessee

Dear 73.

Yes, my subscription to 73 Magazine expired, and I let it die right there. Today I was in Bud Electronics Supply to get some coax, and there on the counter was your current issue.

. . The ad placed by Newsome Electronics with some 6 meter gear was worth the price of the magazine, but . . . the page after page of ramblings by Gus bored me stiff . . . he even tells what he ate, and goes on to try and convince me that there are MDs who leave the operating table to make a QSO with him . . . how silly.

Then we get the page after page of your fan mail. Sooo, I felt you might like to know what I had for supper. I had a hot black coffee as soon as I got home, then about 6 p.m. sat down to some big fat hamburgers, good corn and mashed potatoes, plus some meal bread with apple butter on top, and a glass of milk.

Do you want some copies of my fan mail. I get them in my line of work too, and will be glad to run off some copies for you . . . I'm sure you'd find them of similar interest.

Don't worry . . . I can't go on much longer missing out on my own personal copy of 73, and my subscription will be forthcoming.

Bud Sunkel Rossville, Illinois

Do you call those letters on the past few pages fan mail?

I have been reading and re-reading my April 73 for several weeks now, and am convinced that 73 is the best magazine for the builder and the ham who is interested in keeping up with the state of the electronic art.

... Although I am a League member, I think that the staff at 73 has a good thing going for them, and I sincerely hope you keep up the good work.

In the April 73, I was particularly interested in your

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A.R.C. Sales P. O. Bex 12, Worthington, Ohio 43085 comments on the ARRL, and the difficulty with which ham gear is obtained in various foreign countries. why not have a column in 73 devoted to matching foreign operators, wishing to set up stations, with American hams who wish to help them get started. I feel sure that many of our number would be interested in this, as it would help to insure that we will be able to keep our present bandspace, even in the face of commercial competition.

I hope to hear from you on this idea in a future edition of 73.

Ken Vincent WA7EFP

Dear 73.

Just wanted to say thanks to Jim Fisk, W1DTY, for a very nice "The View from Here" in July 73. It is the most sensible thing I have read in 73 in a long

We need to help and train more new hams, but not let the gate down for them to get in. We just had that experience and you can see what happened.

Herman Whatley W5IJO Pampa, Tex.

Dear 73.

I was very pleased to find in the July issue of 73 Jim Fisk's article on public relations in ham radio. I hope many hams read this article and take it seriously because Jim spoke the truth. As president of our local high school radio club, I hope to initiate a drive for more public relations in our area. If you have any literature or suggestions that might help, they would be appreciated.

Rick Acuncius WA9SOF Bunker Hill, 111.

Dear 73,
... You don't have to be a graduate of M.I.T., or That is the best part of it.

Regarding your article on the decline of ham radio, I would also say that the "DX business, especially on 20 meters" is also hurting ham radio. When you listen on that band a bit, you commence to get a sea-sick feeling over the hello-goodbye, send your QSL to my agent, type of stuff. Since when does a ham operator have to have an agent like a movie star and do they get ten percent commission? Everyone to his own choice, I guess, but for my money it is more pleasure to deliver a message from some overseas man to his relatives and hear the heart-felt thanks you get, than all the QSL cards in the world . . . and I have enough cards to paper the shack,

P. B. Dunn W6WPF Northridge, California

Thank You

Dear 73.

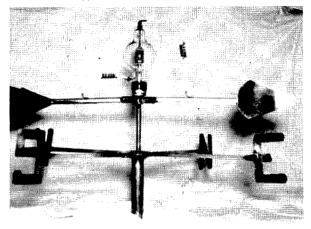
... I wish to offer my sincere thanks to two par-ticular (ham) operators in Wellesley and Hingham, Mass. My wife died of a heart condition while visiting our son who is attached to the Embassy in Santo Domingo.

My only contact with him down there was by these two operators who even were nice enough to call my home by telephone and let me listen to all the details! I will be forever grateful to these two men who in my bereavement put themselves out of their way to keep me in contact. I wrote down their names and stations, but somehow during that time, I mislaid it. Hoping that they read this in your magazine, I remain gratefully.

William F. Leary Hyde Park, Mass.

Thanks should go to Sylvester Connolly W1MD in Hingham, Al Graf W10QP in Wellesley and H18XDC in Santo Domingo.

New Use for Old Tubes



Dear 73.

Enclosed find a picture of a weather-vane I built for a fellow ham to mount on his tower. It is of copper, and stainless steel with 100th wired on top!! Hi . . .

A new use for the 100th?

Joseph Strolm Norwalk, Conn.

Far-East Phone Patches

Dear 73:

I am aboard a destroyer stationed in the South China Sea. About once a month the ship ties up in Subic Bay, Philippines. So far I have found no amateurs in the area, Could you please pass on to me information about amateurs in the Subic Bay-Manila area who could handle phone-patch traffic back to the states?

Bruce Adams Asst Commo Officer USS Brush (DD-745) c/o FPO San Francisco 96601

Can anyone put Bruce in touch with a MARS station in the Philippines?

Gravity

Dear 73:

The Mahlon Loomis Scientific Foundation, P. O. Box 6318, Washington, D. C. 20015, devotes a major portion of its activity to investigation including communication and motivation. Hams interested in more information should write to Mr. Thomas Appleby, Director.

Howard Pyle W70E Mercer Island, Washington



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6021	75U-300B	2 KW	15.95
6022	75U-300U	500	14.95

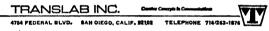
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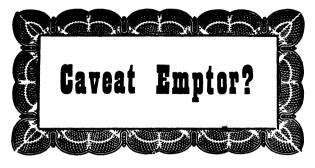
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CONVERTERS. World's largest selection of frequencies. Ham TV vidicon cameras and parts at low factory-direct prices. See them now in our full page ad in this issue. Vanquard Labs, 196-23 Jamaica Ave., Hollis, N.Y. 11423.

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TELETYPE EQUIPMENT for sale: Polar relays, \$2.50; PR sockets \$1.75; 3-headed TD with sync motor \$60.00; Sync motor \$10.00; Other parts available. B. L. Ferris, K4AWR, Box 672, East Flat Rock, N.C. 28726.

W9 DX CENTURY CLUB will hold this year's meeting on September 16 at Holiday Inn of Chicago—O'Hare, Schiller Park, Illinois. G2MI, RSGB QSL Bureau, will be guest DX personality.

HY-GAIN 18-AVQ, brand new in original box. Going for full size 80-meter vertical. Delivered prepaid, \$39.50. WØRA/1, Box 115, Greenfield, N.H. 03047.

Poulsville HAM KENVENTION: September 8-9, 1967. Beautiful Executive Inn Motor Hotel, Waterson Expressway at State Fair Grounds, Louisville, Kentucky. Participate in the technical sessions, forums, prizes, banquet and flea market. Bring XYL for day of women's activities. For information write Louisville Ham Kenvention, Box 20094. Louisville, Kentucky 40220.

TEKTRONIX 511AD 10-MHz scope. Clean with book. Usually \$200 or more from dealers, \$150.00. Popular TS-47A Test Oscillator, 40-500 MHz. CW, AM, Pulse modulation. See June 65 73. Perfect for antenna work and converter alignment, \$75. Knight C-577 compressor, \$10. Power devices regulated power supply, 100-400 V at 200 mA, \$15. Turn on with a three-channel solid-state color organ. Wild for parties, \$75. CushCraft 16 element colinears for 2 and 432, \$10 and \$5. Coveya 6—the six-meter antenna that looks like a TV antenna, but gives 10-dB gain, only \$20. Paul Franson WA1CCH, 38 Heritage Road, Acton, Mass. 01720. 617-263-3184.

KNOB FOR COLLINS 75A receivers, 6 to 1 reduction, \$7 postpaid. Jules Wenglare, W4VOF, 1517 Rose St., Key West, Florida 33040.

CLEGG VENUS mint condition. Hy-Gain beam. Alliance rotator. Expenses force sale. \$400. John Mrozinski, WB2EXI, 155 Eckford St., Brooklyn, N.Y. 11222.

CENTRAL ELECTRONICS 20A like new with 458 VFO, \$75.00. HQ-129X with speaker and Q multiplier, \$50.00. Dick Acker, W9TOK, 5434 S. Kostner Ave., Chicago, Illinois 60632.

SPECIAL SALE: Three-transistor converters, 50-54 mc in, 14-18 mc out. Wired, tested, printed circuit. Crystal controlled, \$6.00. Tuneable, \$5.00. Syntelex, 39 Lucille, Dumont, N.J. 07628.

RITTY MODEL 14 transmitter distributor wanted. Please write me. Dave Deatrick, WA8OLD, 2940 Hickory Lane, Ann Arbor, Mich. 48104.

QSL CARDS???? America's finest samples 25¢ Deluxe 35¢. Sakkers Printers, W8DED. Holland, Michigan 49423. (Gospel QSL samples 25¢).

VIKING 500, \$225. Viking SSB adaptor, \$135.00. SX-101-A, \$175.00, excellent condition. W6FZB, Lou Brummel, 2620 Aragon Way, San Jose, California 95125.

WANTED: HRO-5, good mechanical shape, with coils. Also, Burnell S-15000 50kc SSB filter. John Fredericks, K7GGJ, 314 S. 13th Ave., Yakima, Washington 98902.

SALE: Collins KWM-2, 516F, 30L1, with speaker and phone patch, including cables and manuals, complete, \$1200.00. W4DNT, D. F. Fleshren, 7305 Valleycrest Blvd., Annandale, Virginia 22003, phone 703-560-3604.

THE FRIENDLY FAVORITE: Warren, Ohio, A.R.A. Hamfest, August 27th, Newton Falls. Follow arrows from route 534 and Turnpike exit 14. Contests, swapshop, XYL-YL program.

WANTED: All types of aircraft, ground radios and tubes, 4CX1000A's, 4CX5000's, 304TL's, etc. 17L7, 51X, 618S, 618T, R388; R390A, GRC units. All 51 series. All Collins ham or commercial items. Any tube or test equipment, regardless. For fast, fair action. Ted Dames Co., W4KUW, 308 Hickory St., Arlington, N.J. 07032.

DUMMY LOAD 50 ohms, flat 80 thru 2 meters, coax connector, power to 1 kw. Kit \$7.95, wired \$11.95 pp Ham KITS, Box 175, Cranford, N.J.

WANTED: Tubes, transistors, lab instruments, test equipment, panel meters, military and commercial communication equipment and parts. Bernard Goldstein, Box 257 Canal Station, New York, N.Y. 10013.



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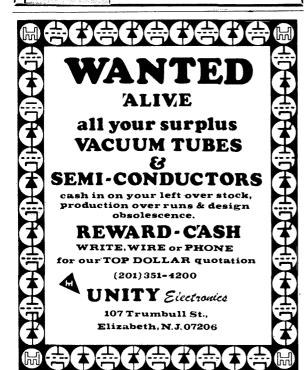
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Grantham School of Electronics, Dept. R. 1505 N. Western Ave., Hollywood, Calif. 90027 SELECTRONIX AUDIO FILTER, use between receiver and speaker or phones, cuts monkey chatter and narrows band pass to about 1000 Hz. Some QSO's possible only with this in circuit. \$24,95 pp. WØRA/1, Box 115, Greenfield, N.H. 03047.

NOVICE AND TECHNICIAN HANDBOOK by W6SAI and W6TNS. Limited quantity for only \$2.50 each. 73 Magazine, Peterborough, N.H. 03458.

WANTED: Military, commercial, surplus. Airborne, ground, transmitters, receivers, testsets, accessories. Especially Collins. We pay freight and cash. Ritco Electronics, Box 156, Annandale, Va. Phone 703-560-5480 collect.

"SAROC" Sahara Amateur Radio Operators Convention 4-7 January, third annual fun convention hosted by the Southern Nevada Amateur Radio Club. Designed for exhibitors and participants at Hotel Sahara, Las Vegas, Nevada. MARS seminar, Army, Airforce and Navy representatives. Ladies luncheon with crazy hat contest, hat should convey amateur radio theme. Plus fabulous entertainment only Las Vegas can present. Registration fee includes three cocktail parties, Hotel Sahara show, hunt breakfast, technical sessions, admission to leading manufacturers and sales exhibits. Advance registration closes one January. QSP QSL and ZIP and telephone number for details to Southern Nevada Amateur Radio Club, Box 73, Boulder City, Nevada 89005.

MONCTON AREA AMATEUR RADIO CLUB, is sponsoring Atlantic Centennial Amateur Radio Convention, at the Brunswick Hotel, Moncton, New Brunswick, September 2-4. Contact Mrs. Audrey Hughes, Chairman of the Registration Committee, at P. O. Box 115, Moncton, New Brunswick, Canada. U.S. Hams planning to attend this should waste no time writing the Department of Transport, Ottawa, Canada, to arrange a permit to operate when there.

MOTOROLA new miniature seven tube 455 kc if amplifier discriminator with circuit diagram. Complete at \$2.50 each plus postage 50ϕ each unit. R and R Electronics, 1953 South Yellowsprings, Springfield, Ohio.

TOROIDS-DIODES-COAX-CONNECTORS. 88 mH toroids— 45ϕ each, 5/\$2.00. 1000 PIV 1 Amp ea, 2/\$1.00. Connectors, Top-Hat Diodes— 55ϕ PL259, SO-239, M359-45¢ ea, 10/\$4.00. Button feedthroughs (while they last) 500 pF @ 500 V. 20/\$1.00. Add sufficient postage. R & R ELEC-TRONICS, 1953 S. Yellowspring Street, Springfield, Ohio.

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TEKTRONIX 511AD scope, 10 MHz bandwidth, good shape with instruction book. \$150. Paul Franson, WA1CCH, 38 Heritage Rd., Acton, Mass. 01720

COMPLETE CONVERSION instructions for the AN/VRC-2, just \$1 while the supply lasts. 73 Magazine, Peterborough, N.H. 03458.

NOVICE CRYSTALS, all bands, \$1.30 each. Also other freqs. Free list. Dealer and club inquiries invited. Nat Stinnette, Umatilla, Fla. 32784.

WANT TO CORRESPOND with Hams and SWLs in USA and other parts of the world. Would also like to receive club magazines from radio clubs. K. Harvant Singh, 31, (774), Upper Museum Rd., Taiping, Perak, West Malaysia, Malaysia.

WANTED: Copies of VHFER magazine, years 1963 and 1964 for personal collection. WIDTY, RFD 1, Box 138, Rindge, N.H. 03461.

1963 BOUND VOLUMES OF 73. \$15 each from 73, Peterborough, N.H. 03458.

SIX ASSORTED ISSUES at ATV Experimenter, circa. '64-65, \$1 from 73 Magazine, Peterborough, N.H. 03458.

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HT-32A \$250; 2B/2BQ/50 & 100 kc cal. \$200; KW Kompact/AC PS \$105; All parts for pr 3-400Z's linear & PS \$200. Dave Windisch, K3BHJ, 3402 Oakenshaw Pl., Baltimore, Maryland 21218 Call 301-235-0466

73 Magazine CUMULATIVE INDEX

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100	T	.07
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400	1	.12
600	1	.20
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1000	1	.50
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1400	1	.85
1600	İ	1.00
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PRV	-	3 A	Ī	7A	1	20A
50	1	.35	1	.50	T	.80
100	ī	.50	Ī	.70	T	1.35
200	j	.75	1	1.05	1	1.90
300	ļ	1.25	1	1.60	T	2.45
400	Ī	1.50	1	2.10	1	2.85
500	1	1.75	i	2.80	1	3.50
600	1	2.00	ì	3.00	-	
700	1	2.25	1	3.50	1	
1000	3		T	5.00	2000	

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5 AMP-TO-66

PRV		
100	1	.90
200		1.40
300	1	1.75
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HAM TV: RCA TM6-B monitor, excellent, with console, also excellent film camera (RCA) with good 1,0., also TA-5 stab amp., WP-33 and 580D power supplies. RTTY one excellent, model 19 complete \$100, 2-mainliner TU's with built in scopes, 125.00 ea, also one new condition SX-115 receiver \$300.00. W4AIS, 7 Artillery, Taylors, S.C. 29687

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HRO RAS receiver \$40. Atwater Kent model 55C, RCA Radiola 66, Philmore crystal set, plus parts of DC sets \$75. 3 antique wall telephones \$75. WA9IYF, Box 22, Milan Ind. 47031.

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HY-GAIN 18HTB HY-TOWER, new model, 10-80 meter vertical, complete, never installed, \$110. Leslie Acton, RR2, Box 234, Indianapolis, Indiana 46231. Phone 317-839-4124.

piscount prices and time payments. New equipment in factory sealed cartons at discount prices. Pay only 10% down, monthly payments as low as \$10. Swan SW-350, \$365; SW-500, \$430; SW-250, \$286; Ham-M, \$99.95; Drake TR-4, \$511; R-4A, \$349.50; T-4X, \$349.50; L-4, \$599; Galaxy V Mark II, \$365; SB-34, \$360; SBE Linear, \$219; Save up to 25%. Write for quote before you pu-chase. Reconditioned bargains: NCX-3, \$199; SW-240, \$179; Eico 753, \$159; SB-33, \$159; SW-350, \$299; Galaxy V, \$299; HT-37, \$179; HT-32, \$179; GBS-100, \$125; SX-117, \$199. Send for list. Bryan, W5KFT, Edwards Electronics, 1320-19th Street, Lubbock, Texas or call 806-762-8759.

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HALLICRAFTERS SR-500 with mobile power supply, brackets, mike and speaker. Excellent condition. \$275.00. WAØIMK, Bill Brogdon, 13720 Vincent Ave., Burnsville, Minnesota 55378.

REED RELAYS SPST-N.O. Coil rating: 2.9 volts at 12 ma. Contacts rated for 12 VA; max. 300 volts or 0.50 amp. Sample usage circuits included. Body size 1" x $\frac{1}{2}$ ". New low price \$2.35 plus 25ϕ handling and postage. Airstar Products, P. O. Box 323, Marion, Iowa.

GREATER BAY AREA HAMFEST will be held again this year at the Edgewater Inn, Oakland, California, on October 14 and 15, 1967. For full information write to Greater Bay Area Hamfest, P. O. Box 545, Hayward, California 94543.

HEATHKIT: HW-22 40-meter SSB transceiver \$70. HP-13 mobile supply \$40.00. IM-32 VTVM \$25. IG-42 RF generator \$30. Millen 90662-A GDO \$35. Hallicrafters TO keyer \$45. Vibroplex key \$15. Ten TF transistors including several 1-watt out 400 mc \$10. K7AZB/6, 1837 Clarke Ave., Apt. 13, Palo Alto, California 94303.

CALL LETTER BILLFOLDS: Hand tooled men's economy \$7.00; ladies' or men's deluxe \$8.50; key cases \$3.00 and \$5.00, PPD U.S.A. Jane Freestone, Route 1, Box 122, Hardy, Arkansas 72542.

TRADE 4-1000A tubes excellent for Ruger 22 single six, High Standard or Colt automatic, also 22 Ruger rifle. W6WGJ/5, 4215 Darwood Drive. El Paso, Texas 79902.

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12	.25	.50	.75	.90
18	.20	.30	.75	1.00
45	.80	1.20	1.40	1.90
160	1.60	2.90	3.50	4.60
240	3.75	4.75	7.75	10.45
D. C.	400PIV	600 Piv	700PIv	900Piv
Amps	280Rms	420Rms	490Rms	630Rms
3	.40	.50	.60	.85
ΙŽ	1.20	1.50	1.75	2.50
18	1.50	Query	Query	Query
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73

OCTOBER 1967



INCENTIVE LICENSING

See Page 2

73 Magazine

October 1967

Vol. XLVI No. 10

Jim Fisk WIDTY Editor

Kayla Bloom WØHJL Assistant Editor

Jack Morgan KIRA Advertising Manager

Published by Wayne Green, W2NSD/I

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Incentive Licensing

We have been waiting with baited breath for over two years for the outcome of the incentive licensing proposal contained in Docket 15928, and now that it is here, it isn't such a hard pill to swallow after all. Although the new law, which goes into effect November 22, 1967, includes exclusive frequency bands for the Amateur Extra and Advanced licensees, the provision for special call signs for each class of license was dropped.

If you will remember, Docket 15928 proposed a new class of license, the Amateur First Class, intermediate in difficulty between the General and Extra Class. This class was to require an advanced technical test and a code test at 16 words per minute. Under the new regulations, the First Class License was dropped in favor of a new Advanced Class license. This new class of license entails a more advanced technical test than the General Class, but the code speed will remain at 13 words per minute. In other words, if you already hold a General ticket, you won't have to take the code test again-all you need is a passing score on the advanced technical test.

Also, there is no waiting period for the new Advanced Class license. You don't even have to hold another license; a new ham may go directly into the Advanced Class if he can pass the test. In addition, amateurs who hold the old Advanced Class license will be accorded all the privileges of the new Advanced Class without any further tests.

The exclusive frequency bands for the

Amateur Extra and Advanced Class licensees are outlined in the table below. In addition to the exclusive frequencies on our 80, 40, 20 and 15 meter bands, the Extra and Advanced Class are provided with exclusive frequencies on six meters—100 kHz in 1968 and 250 kHz in 1969. Since none of the exclusive band segments go into effect until November 22, 1968, everyone has adequate time to qualify for a higher license class.

The only other main point in the new law concerns the Novice license. In the future the Novice license will be issued for a period of two years, non-renewable, and, on November 22, 1968, Novice radiotelephone privileges on 145-147 MHz will be deleted.

The FCC, in concluding its action on incentive licensing, said, "In reaching its conclusions, the Commission has made every reasonable effort to provide an opportunity for the remodeling and revitalization of the Amateur Radio Service without changing its basic character and spirit and without depriving any amateur licensee of the major portion of his present operating privileges. It remains only for a licensee to prove himself and to improve the Amateur Radio Service by voluntarily upgrading his license to the highest level of achievement of which he is capable. We are confident that we can rely on amateurs in this regard and that, therefore, this incentive licensing program will result in a radio service which will be a source of pride to both amateur licensees and the Commission." I concur.

. . . Jim Fisk W1DTY

	PHONE ALLOCATION			CW ALLOCATION	
	Extra Class	Advanced Class	General Class	Extra Class	Advanced and General Class
Current	3.8 - 4.0 7.2 - 7.3 14.2 - 14.35 21.25 - 21.45 28.5 - 29.7 50.1 - 54.0	3.8 - 4.0 7.2 - 7.3 14.2 - 14.35 21.25 - 21.45 28.5 - 29.7 50.1 - 54.0	3.8 - 4.0 7.2 - 7.3 14.2 - 14.35 21.25 - 21.45 28.5 - 29.7 50.1 - 54.0	3.5 - 4.0 7.0 - 7.3 14.0 - 14.35 21.0 - 21.45 28.0 - 29.7 50.0 - 54.0	3.5 - 4.0 7.0 - 7.3 14.0 - 14.35 21.0 - 21.45 28.0 - 29.7 50.0 - 54.0
November 22, 1968	3.8 - 4.0 7.2 - 7.3 14.2 - 14.35 21.25 - 21.45 28.5 - 29.7 50.1 - 54.0	3.825-4.0 7.2 - 7.3 14.2 - 14.35 21.275-21.45 28.5 - 29.7 50.1 - 54.0	3.85 - 4.0 7.225 - 7.3 14.235 - 14.350 21.3 - 21.45 28.5 - 29.7 50.1 - 54.0	3.5 - 4.0 7.0 - 7.3 14.0 - 14.35 21.0 - 21.45 28.0 - 29.7 50.0 - 54.0	3.525 - 4.0 7.025 - 7.3 14.025 - 14.35 21.025 - 21.45 28.0 - 29.7 50.0 - 54.0 (A) 50.1 - 54.0 (G)
November 22, 1969	3.8 - 4.0 7.2 - 7.3 14.2 - 14.35 21.25 - 21.45 28.5 - 29.7 50.1 - 54.0	3.825- 4.0 7.2 - 7.3 14.2 - 14.35 21.275- 21.45 28.5 - 29.7 50.1 - 54.0	3.9 - 4.0 7.25 - 7.3 14.275 - 14.35 21.35 - 21.45 28.5 - 29.7 50.25 - 54.0	3.5 - 4.0 7.0 - 7.3 14.0 - 14.35 21.0 - 21.45 28.0 - 29.7 50.0 - 54.0	3.55 - 4.0 7.05 - 7.3 14.05 - 14.35 21.05 - 21.45 28.0 - 29.7 50.0 - 54.0 (A) 50.25 - 54.0 (G)

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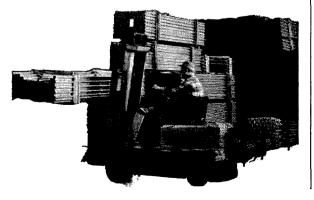
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Katmandu, Nepal

After a week in the oppressive heat of Delhi. I was most enthusiastic to be on my way to Nepal. This would undoubtedly be the most remote part of the world that I would visit on my trip. I carefully reconfirmed my airline reservations on Royal Nepalese Airlines and appeared at the airport right on time to check in for the flight. 'Oh, that flight just left a few minutes ago."

It seems that the schedule had been changed and no one had mentioned this to me. As I took a taxi back to my hotel I wondered what Father Moran 9N1MM would think when the plane arrived without me. Fortunately there was a flight tomorrow, so my trip schedule wouldn't be too much off. I would just have to stay in Nepal for one day instead of two, as planned.

It was just as well that I had an extra day to rest. Delhi-belly had set in with a vengeance, and I found myself dizzy and very tired, to boot. Even worse, I'd lost my Lomotil pills in the taxi yesterday. A traveler in Asia without his diarrhea pills is in bad shape.

The next morning I felt a little better and caught my plane with no problems this time. Father Moran was right there waiting for me as I got off the plane. He, and a friend, Bob, from the American Embassy, drove me into Katmandu and explained about the country. Father Moran moved up here to Nepal in 1951 after some twenty years in India. He is a Jesuit missionary and runs the foremost school in Nepal. When he arrived there was no airport in the country and no roads into it, at all. There were a few roads in Katmandu, and those very few cars that were here, had been brought in over the mountains on platforms on the backs of men.

The road into Nepal is out right now. The rains caused a section to collapse and they are busy digging a new road out of a mountainside. The road is about 85 miles long, has over 1500 sharp turns, and covers a distance of about 25 miles as the plane flies. With the road out, there are food and gas shortages in Katmandu and no relief is in sight for several more weeks.

India has kept Nepal undeveloped for many years, probably as a buffer between (Turn to page 92)

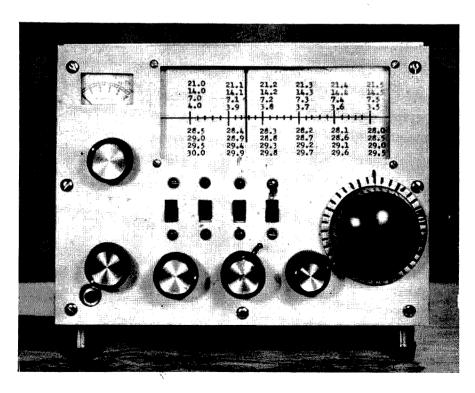
The 2Q Communications Receiver

A 22-transistor design using FET's.

A strong desire to duplicate the popular Drake 2-B receiver in transistor form, prompted the building of the receiver shown. It is the result of over two years of experimental design, building, rebuilding, testing and listening. The block diagram in Fig. 1 closely resembles that of the Drake, and for that reason I have named it the 2Q.

The completed receiver is a triple conversion superheterodyne, covering all amateur bands 10 through 80 meters. It has excellent sensitivity, selectivity and stability. Cross modulation has been reduced to a minimum by the use of FET transistors in both the rf and first mixer stages. Such features as bandpass tuning, FET detector, 8-meter, age and a 100 kHz crystal calibrator are included.

The circuit shown in Fig. 2 is actually the result of two that were built. The first design, following the usual transistor circuit theory, matching impedances, etc., resulted in a receiver that lacked the necessary sensitivity and selectivity. Cross modulation was also a problem because bipolar transistors were used in the front end. The second design is the result of a concentrated effort toward obtaining maximum selectivity by the use of small capacity coupling where possible, high Q tuned circuits, and tapping collectors down on the coils to preserve their O. Cross modulation was reduced to a minimum by using FET transistors in both the rf and first mixer stages and by using a separate rf gain control.



Front view of the 2Q transistorized receiver. Bottom, left to right, are the phone jack, bandswitch, if gain, band-pass tuner, selectivity switch combined with rf and volume control, and main typing. Switches, left to right, are agc S-meter switch, dial light, 100 kHz calibrator and bfo.

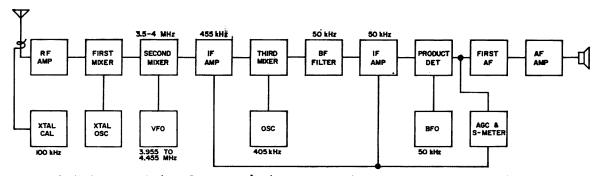


Fig. 1. Block diagram of the 2Q, a completely transistorized communications receiver of modern design using FET's in the front end.

The circuit

Much has been written on transistor circuitry during the past few years so I will be as brief as possible and describe only those points which I think important or unusual.

Capacitive coupling is used throughout the (preselector). It uses high-Q front end toroid coils and slug-tuned coils. The simple switching provides the necessary selectivity and ease of adjustment desirable when compact construction is used. Ami-Tron toroids were not used for the 15- and 10-meter bands due to the lack of space for the necessary trimmer capacitors, but their use is definitely recommended for all bands. The selectivity and stuffing ratio gained by their use is very necessary. The tuning capacitor, a two-gang trf unit, was reduced to 200 pF per section. Space for the rf choke was solved by placing it in the crystal oscillator compartment.

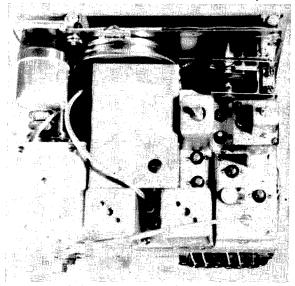
The FET mixer, using source injection, is capacitively coupled to the second mixer. The circuit, possibly of my own design, was preferred to a gate injection circuit. The only FET's available were N-channel 2N3823's, but possibly some of the cheaper ones will work as well.* I intend to try the Motorola MPF 105 FET when I can locate a distributor who stocks them. Alignment of the front end is simply a matter of adjusting turns, spacing, and trimmer capacitors, until the amateur bands are staggered across the preselector dial.

The 3.5 MHz-4.0 MHz variable if, mixer and oscillator section, consists of a high-C Colpitts oscillator, and a base injected mixer, with an output at 455 kHz. Only the highest quality components should be used here, *2N3819 FET's seem to work as well as the more expensive 2N3823's. With the 2N3819, the only circuit changes were in the rf amplifier—the source was grounded and B+ thanged to 14 V. Motorola MPF-103's have been tried too. At 90¢ each they seem to work as well and their specs are almost identical.

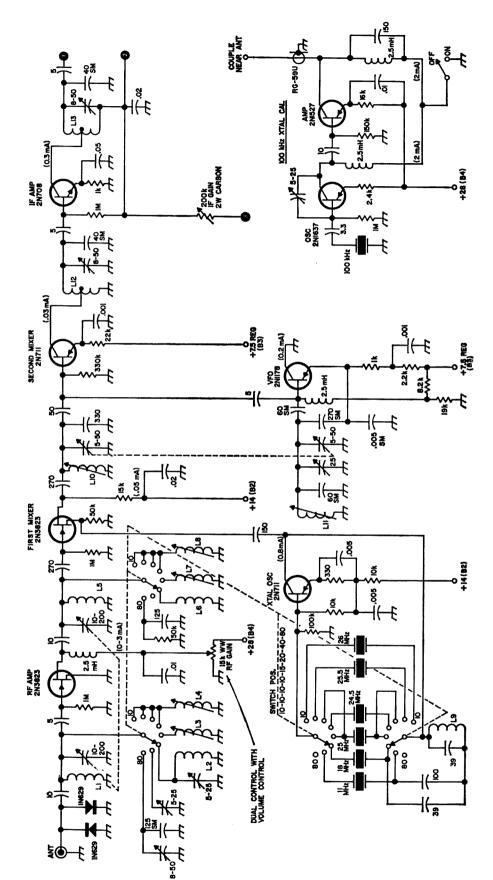
since it is a major frequency determining circuit.

Only one stage of amplification was found necessary for the 455 kHz if section. The mixer is capacitively coupled with base injection at 405 kHz from a high-C Colpitts oscillator giving a 50 kHz output. Here again the oscillator is a major frequency determining circuit and care should be used in its construction. The 455 kHz if coils can be any high-Q center tapped units, preferably using toroids or cup cores. This is a good spot for a mechanical filter; something I intend to try in the near future.

The band-pass tuner was constructed using coils wound on 1" diameter powdered iron toroids from an old telephone company audio filter. The ones I used were blue and numbered A9301572. The tuning is done with a three-gand trf type broadcast tuning capacitor, with a stop added to limit its travel to about 20 degrees, starting from maximum. The switch uses a hollow 14 inch shaft, with

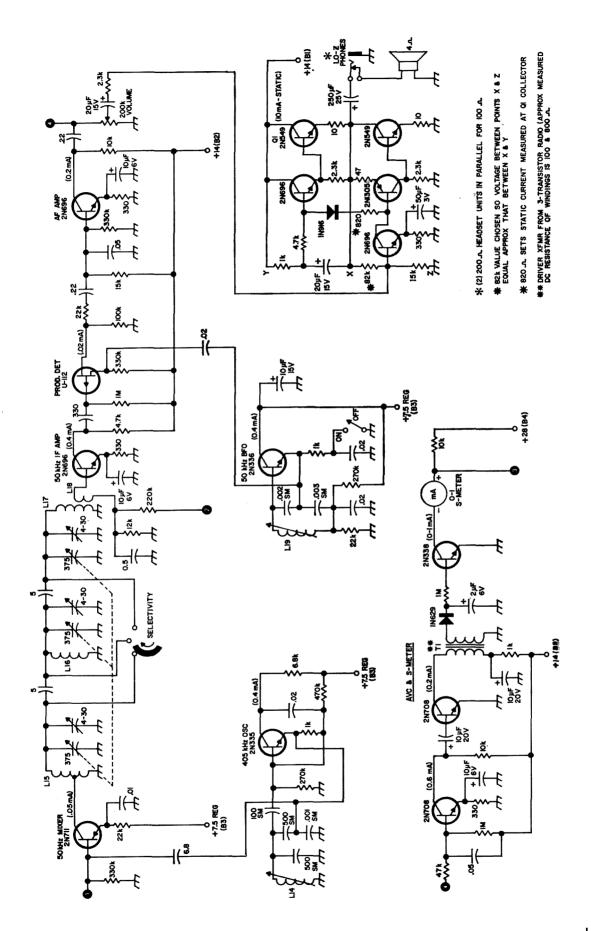


Top view of the 2Q receiver, showing the layout of the various parts.



used were 3-pi types on 1/8-inch iron cores taken from a surplus computer board although miniature 2.5 mH units should work ok. Coil values are given in Table Fig. 2. Schematic diagram of the 2Q communications receiver. The currents shown in parenthesis are the collector currents for each stage. The rf. chokes . Later experimentation by W5ETT indicates that the bias network used with the 2N708 455 kHz if amplifier was not too tolerant to different transistors. He recommends removing the IM base-bias resistor and replacing it with a 330k resistor and a 27k resistor from base to ground.

*T-68-2 and T-50-6 toroid cores may be purchased from Ami-tron Associates, 12033 Otsego Street, North Hollywood, California. Price 50¢ each plus postage.



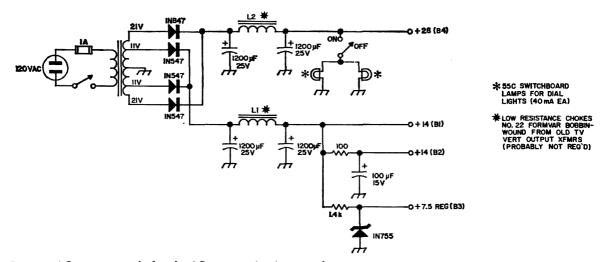


Fig. 3. AC power supply for the 2Q communications receiver.

the TC shaft being operated through it.

The FET detector using a P-channel U112 or 2N2497 has plenty of bfo injection and works very well on SSB.

Good S-meter action and a certain amount of gain control is provided by the circuit shown by simply reducing the amount of voltage applied to the *if* transistors.

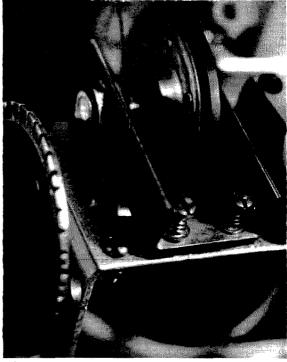
I had some trouble getting the 100 kHz crystal calibrator aligned with WWV, so it was necessary to devise the circuit shown. WWV may be received on the receiver, dur-

Table 1. Coils for the 2Q receiver.

- L1 32 turns #22 Formvar on T-68-2 toroid core.
 L2 20 turns #22 Formvar on T-50-6 toroid core.
 L3 L4 20 turns #22 Formvar 1/4" diameter with
- L3, L4 20 turns #22 Formvar, 1/4" diameter with last 6 turns spaced to take a 1/2" long powdered-iron core.
- L5 Same as L1 except 33 turns.
- L6 Same as L2 except 23 turns.
- L7 Same as L3 except 23 turns.
- L8 Same as L3 except 23 turtis.
- L9 30 turns #24 enameled, 1/4" diameter.
- L10 22 turns #24 enameled on 1/4" slug-tuned form.
- LII 15 turns #24 enameled on 1/2" form, spaced diameter of wire. 3/8" powdered-iron slug.
- L12, L13 110 turns, 6-strand Litz wire, tapped at 55 turns. Pi wound on 1/2" diameter ferrite cupped core 11/2" long. Three cups stacked to obtain necessary length after grinding out center of middle core.
- L14 120 turns, 6-strand Litz wire, pi wound on 1/4" slug-tuned form.
- L15, L16, 330 turns using 3 strands #29 enameled
 L17 wire wound on powdered-iron toroid 1"
 diameter, #A930157-2. Toroid cores from
 old telephone equipment will work. L15
 tapped 50 turns from ground end.
- L18 10 turns #22 Formvar wound over L17.
- L19 800 turns, 6-strand Litz wire, layer wound 1" long on 1/4" slug-tuned form.

ing daylight hours here, by putting it on 7 MHz and tuning the preselector to minimum capacity.

From this point, the rest of the receiver is simply audio, six transistors in all, with a transformerless audio circuit taken mostly from a GE transistor manual. The power supply, one left over from another project, is no doubt overfiltered. Any well-filtered dc source of 14 V and 28 V will do. The receiver draws 20-125 mA depending on volume. The dial lamps use an additional 40 mA each. The receiver will work well on only 12-14 V, but the S-meter and AGC will be out of the picture.



Close up view of the dial tuning mechanism.

Choice of transistors

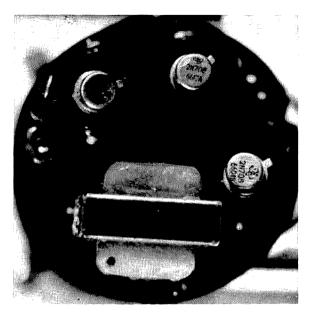
The transistors used are by no means the only ones which will work in the receiver. My choice was made largely from tests with the ones which were available in my transistor junk box. Either PNP or NPN will work in most circuits, NPN being preferred in most cases for *if* and oscillator traisistors. Oscillator types should be those that have no internal connections to the case. The use of sockets for all transistors is highly recommended.

Construction

The receiver cabinet measures 8½" long x 6½" high x 6½" deep. The receiver is divided into a number of sub-assemblies mounted on a main chassis, made of 14-gauge aluminum. The sub-chassis are of 21-gauge aluminum.

Only the 50 kHz if amplifier and audio stages were built on the main chassis. The S-meter and age circuitry were mounted on the back of the S-meter. Fig. 4 is a rough layout of the front panel.

The slide rule dial has a tuning rate of 45:1 or 45 turns of the tuning knob to cover 500 kHz. This gives at least 25 revolutions on the 40 and 20 meter bands. The mechanism consists of a weighted knob on a ¼" shaft driving a 2" rubber tired wheel (Jenson #J1490-01) on a ¼" shaft driving a dial cord to a 3½" dial drum on the tuning capacitor. The dial scale was made on white paper (pasted to a piece of stiff cardboard) using a black ball point pen and a typewriter. The



Back view of the S-meter. One of the 2N708's (Q15) was replaced with a 2N338 after this photo was taken for better agc and S-meter action.

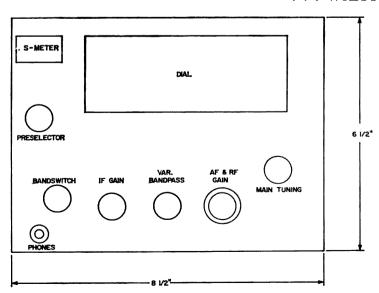
dial drum was made from a reinforced, nickle-plated lid from a peanut butter jar.

Conclusion

No wild claims shall be made for this receiver except to say it is the best homebrew receiver I have ever owned. Only 5 feet of wire strung up in the shack has been found necessary for good reception. Many hours were spent just listening and hearing signals that I could never hear with my old 14-tube homebrew receiver. I would like to thank Jim Miles W5KWJ for his comments and encouraging me to write this article.

. . . W5ETT

Fig. 4 Front panel layout used by W5ETT in the original model of the 2Q receiver.



A Really Rugged Rotator

Whether he is an old-timer or raw beginner, there are probably very few hams who are not somewhat familiar with the old reliable prop-pitch motor. Just after World War 2, the surplus market saw a veritable flood of them, and, along with coaxial cable, they caused quite a revolution in the construction and operation of rotary antennas. Many of the motors which were put into use right after the war have performed faithfully over the years, and even today there is really nothing which can approach them for sheer power and ease of operation.

Before the prop-pitch motor may be used as a rotator, the brake assembly and limiting dogs are usually removed and some sort of coupling or bracket is welded to the output gear. The motor is then mounted vertically inside the tower and supplied with 24 volts ac or dc. Refinements such as remote controls and direction indicators are left up to the imagination of the owner.

One of the very few faults with his arrangement is the tendency for moisture to collect inside the motor housing, especially on the brushes, with the result that the motor turns very erratically or not at all. It goes without saying that this usually happens in the winter, just when the rig is being used the most and when the working conditions at the top of the tower are

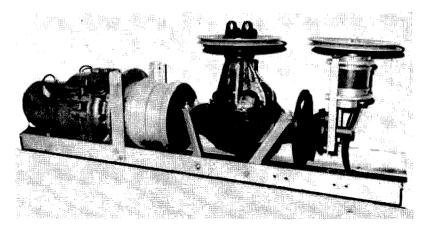
at their worst. I have known hams who have gone to amazing lengths to prevent this, but in most cases the solutions have not been too successful.

Another point, particularly in cold climates—the oil in the gear box congeals putting quite a load on the motor. This causes very slow starts and extremely slow rotation of the antenna. Since the usual rotation speed of the output gear is only about three-quarters of an rpm, any further decrease is intolerable. It is possible to open the gear box and pin one set of planetary gears, which will approximately double the output speed, but many hams apparently would rather put up with the slow speed than monkey with the gear train.

Before starting on the construction of my own rotator, I thought over all the pros and cons of the situation and eventually came up with a unit which seems to overcome all these problems. Construction is quite simple and the cost is very reasonable.

The biggest factor in this rotator was the decision to mount the motor in the horizontal plane, just as it was in the aircraft. The ideal approach at this point would be to procure the mating gear which originally was on the end of the propeller blade, but this is apparently impossible to find. It seems equally difficult to find any other suitable gear, so this idea was soon

The really rugged rotator on the bench at VEITG before it was mounted on the tower.



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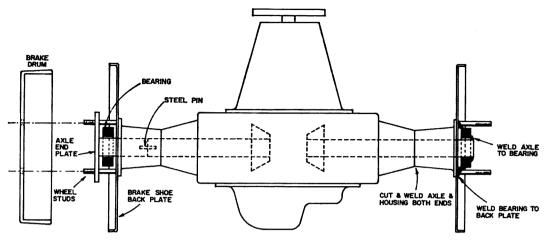


Fig. 1. Mechanical details of modifying the automobile differential before installing the prop-pitch motor.

forgotten. The problem is to find a way to obtain a right-angle drive, along with a bearing, which will support the heaviest possible antenna load. The most common item which comes to mind is the differential or automobile "rear-end". Certainly it is the most available! In addition to being a right-angle device, it is extremely sturdy, and if properly set up, it will provide a stepup speed ratio. The exact ratio will depend upon the original design of the associated car, but it will be somewhere around 2 to 1, or a little better. When the prop-pitch motor is coupled to the axle of the differential, the drive shaft turns at 11/2 to 2 rpm, thus solving one of the major drawbacks of the prop-pitch motor without modifying it. There is no problem with the differential being able to support the antenna, and the strength of the internal gears is far in excess of any torque which the antenna will exert.

By mounting the motor horizontally, any moisture which collects inside the motor housing will run to the bottom and a small drain hole will take care of it. With the infrequent operation and very high quality of the gears, it is doubtful if any oil is actually required for lubrication. It can either be drained out completely, or a small amount left inside. With the horizontal mounting, the gears will pick up some lubrication during each revolution if a small quantity remains in the box. In any case, the problem of congealing is eliminated.

We have therefore overcome the major drawbacks of the prop-pitch motor and can proceed with the actual construction. Because of the length of a car rear-end, it would be too ungainly to mount in the average tower. In fact, it must be understood at once that this rotator is quite heavy, but since it is intended for use with large and heavy arrays it would be necessary to have a heavy-duty tower. It is ideal, of course, for the windmill type of tower, or for base mounting with a long drive shaft.

A quick inspection of the nearest junk yard will provide the rear-end you need. It is best to look for small cars, since even the smallest unit will be satisfactory. I found an old Morris rear-end which was ideal from the size and ratio standpoints. Make sure the brake drums are still on the unit, but remove them when you get home. One brake drum is positioned on the output gear of the prop-pitch and welded to it. Make sure that this is done carefully and accurately, as it is going to provide the coupling between the prop-pitch motor and rear-end after it is modified. This is also a good time to remove the brake assembly and dogs from the motor, and drain out the oil if you live in a very cold climate. Also pull out the motor power leads, and label themclockwise, counter-clockwise and common. You may have to hook up 24 volts temporarily to find out which is which, but this should only take a few minutes. If you expect to be digging for weak signals, the motor should also be fitted with filtering capacitors from each brush holder to ground. Small micas can be used but the .002, .001 or even .01 disc ceramic is more convenient because of its small size. These steps will complete the modification of the motor itself.

The next step is to cut down the rear-

end. First of all, remove both axles and set them aside. Then cut off both axle housings within one or two inches of the gear housing. If a power hacksaw is available, the job may seem easier, but the shape of the unit makes it difficult to hold steady. An ordinary hand hack-saw is entirely adequate and is actually easier to use. In order for the unit to transfer power from one axle to the antenna drive shaft, the other axle must be prevented from turning. The easiest way to do this is to insert one axle into its normal gear in the rear-end, then cut it off flush with the gear housing, and weld it to the housing itself. However, a study of the photograph will show a little more elaborate arrangement. The axle housing is cut off near the brake shoe assembly. The axle is inserted through the bearing in the brake assembly and on into its mating gear. The brake assembly is welded to the gear housing, the axle is cut off flush with the end of the brake-assembly bearing, and then welded to the bearing. The bearing in turn is welded to the brakeassembly.

The end result is the same, but now the backing plate can be used to help form a mounting bracket arrangement for the complete rotator.

The other side of the rear end must be modified with more care to ensure proper coupling to the motor. The actual coupling is accomplished by using the wheel mounting studs on the axle to mate with the corresponding holes in the brake drum which was welded to the prop-pitch output gear. By using this arrangement, the motor can be quickly removed for servicing by merely removing the mounting brackets on the motor itself and sliding it away from the differential.

In order to construct the coupling, both ends of the axle must be used. The splined end should be inserted completely into its mating gear, and the axle cut off flush with the edge of the gear housing. Now, note that the remaining piece of axle must be cut off about three inches from the round plate on the end. This piece of axle (with the plate on it) must be welded to the piece which is inserted into the gear. The result will be a much shorter version of the original axle. It is best to have the two pieces welded together. Any reasonably good machine shop can do this. When this new axle is inserted in place, the axle housing must be carefully measured and cut off in such a way that it can be inserted through the brake-assembly bearing, the

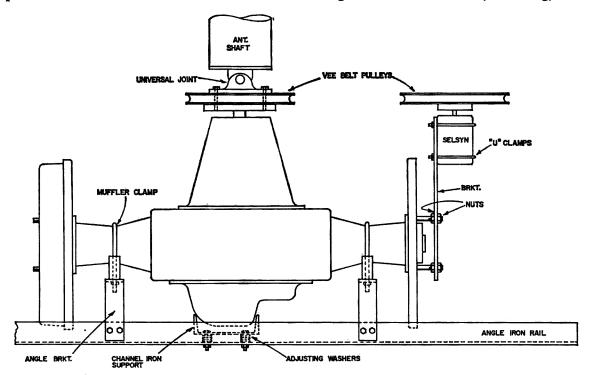


Fig. 2. Mounting details of the differential, selsyn drive, and antenna drive shaft. The mounting brackets can be made as shown here, but in the photo, brackets were made of scrap material and the muffler clamps mounted upside down. Either method is satisfactory.

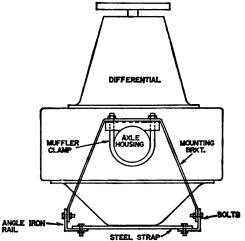
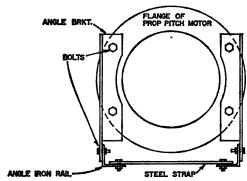


Fig. 3. Side view of the rail-mounted differential and plate on the axle can mate properly with the studs on the brake assembly, and the housing can be welded to the differential housing. Fig. 1 will probably make this more clear than the verbal description. After the axle has been fitted and the housings welded to each other, the brake drum can be slipped over the studs and fastened onto the axle plate with the two or three original screws. The studs are now in place, ready for insertion into the holes on the proppitch drum.

The entire assembly must now be mounted, and probably the simplest way is to use two lengths of heavy angle iron or aluminum to form support rails. The prop-pitch motor is laid horizontally between the rails, with the gear case housing providing its own support. Two short pieces of angle are bolted to the side rails and to the large flange of the motor gear box. This prevents any rotary movement of the motor. Two other pieces of angle are used to hold the rails together, otherwise the weight of the motor tends to force the rails apart and put the entire weight on the bolts in the side pieces of angle. See Fig. 3.

The differential assembly is coupled to the prop-pitch motor and carefully adjusted so that the whole affair is level both end to end, and side to side. Mounting brackets can then be made out of mild steel strap. The brackets are first fastened to the housings by standard muffler clamps, making sure the assembly is level. Then the legs of the brackets are bolted to the side rails. Unless a large unit is used, it's not likely that the bottom of the differential will be resting on the edges of the rails. To provide additional support, a piece



prop-pitch motor.

of channel steel should be used to support the under-side of the differential, with its height being adjusted by washers or sheetmetal shims. Fig. 2 and 3 show this arrangement.

The top of the differential must now be coupled to the antenna drive-shaft. As the differential itself will have a heavy plate attached to the internal gearing, a mating plate or flange can be cut from stock and welded to the antenna drive-shaft. Matching holes are drilled in the flange and then the flange is bolted to the differential plate. A more flexible arrangement can be made by procuring the universal joint and possibly even the entire drive shaft of the original car. In my case, the rear-end cost me \$5.00 and the drive shaft was thrown in for nothing, so cost was no factor. By using the universal joint, some mis-alignment between rotator and antenna can be tolerated, and the shaft can be quickly uncoupled if

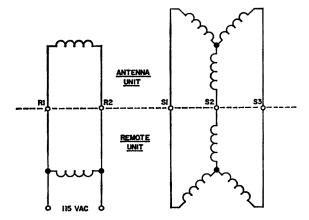


Fig. 4. Interconnection for the selsyn motors. A four-wire system may be used if terminals R2 and S3 are run on the same wire.

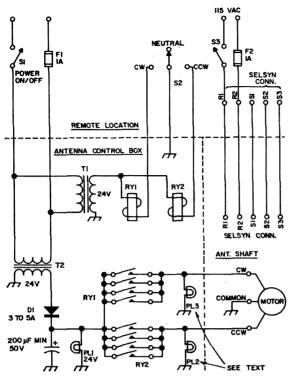


Fig. 5. The complete remote-control system for the really rugged rotator. If suitable 24-volt relays cannot be found, two 12-volt automobile horn relays may be used with a dropping resistor.

necessary. See Fig. 2. The last step in the rotator itself is the direction indicator, and for this purpose there is really nothing that can do as good a job as a pair of selsyns. Many units are still available on the surplus market, though the easiest to use are those designed for 115 Vac. The hook-up for the selsyns is shown in Fig. 4. Mechanically, the antenna selsyn is mounted on a metal plate with two home-made U-bolts. The plate is mounted on the wheel studs of the brake assembly opposite the prop-pitch motor. The drive system from the antenna shaft to the selsyn consists of two V-belt pulleys of equal size, and the V-belt itself. The cheapest suitable pulleys are made for use on laundromats or dryers, and are available from any appliance service shop. The correct size V-belt can be obtained at the same time. The first pulley is drilled to accept the same bolts which couple the differential to the antenna shaft, and the second is mounted onto the shaft of the selsyn. It will probably be necessary to make up some sort of mounting plate and possibly a set-screw arrangement. This depends upon the type of pulley used as well as the type of synchro. See Fig. 2 for details.

A suitable terminal board should be provided to handle the three motor-control wires and the five selsyn wires. In addition, a weather-proof cover should be made up to cover at least the selsyn and terminal board. The motor and differential are well able to stand the weather just as they are.

The control method which is used will depend upon the desires of the individual and the available materials. All that is really necessary is a means of getting 24 volts ac or dc to the motor, and switching it between the cw and ccw wires. The selsyn wires are merely connected to the remote selsyn, and the remote unit is fitted with an indicator needle and some sort of compass scale. The antenna is pointed north, the remote selsyn housing is loosened and turned until the needle points north on the scale, and the housing tightened up.

However, a more elaborate control unit is illustrated in Fig. 5. Since the unit is mounted on the tower, the low voltage, high current leads to the motor should be as short as possible. A pair of 4-pole doublethrow relays handle the motor switching. with all poles wired in parallel to minimize the possibility of arcing or burned contacts. The 24 volt ac supply is rectified with a high-current silicon diode, filtered and the resultant dc used to feed the motor. While not necessary, the motor seems to run quieter and smoother on dc than ac. The 24-volt transformers and relays used in this unit were salvaged from pin-setting machines in a defunct bowling alley, but any similar components will be suitable. Alternatively, a pair of 12-volt units can be hooked in series, and a couple of automobile horn relays used for switching.

On this particular unit, a large 24-volt pilot lamp is mounted on the side of the control box and is visible from the ground. It monitors the output dc immediately before it is applied to the direction relays. This is being modified to two lights, which will be connected directly to the motor input leads. Should the antenna fail to turn at any time, a quick look at the tower will show whether or not voltage is getting to the motor. This will immediately point out motor trouble or control unit trouble (or burned-out bulbs! ed.) and is a handy trouble-shooting aid.

The resultant rotator is very rugged and will prove suitable for the largest and heaviest stacked arrays.

Designing Permeability-Tuned Coils

If you have trouble designing slug-tuned coils for your construction projects, here is an approach that is simple and almost foolproof. It even shows you how to use those old slug-tuned forms that you have in the junk box.

Within the last decade, the development of improved ferrite core materials, stemming from basic research into the nature of magnetic materials, has brought about a quiet revolution in the art of coil design. Inductors wound on powdered iron require fewer turns of wire for a given inductance than conventional aircore units, which not only permits them to be more rugged and compact, but also reduces their dc resistance, thus raising Q. In addition to packing a lot more coil into less space, such an inductance may be easily varied-without taps or unreliable sliding contacts-simply by sliding the core in and out of the coil (permeability tuning).

Recently, needing a dozen of them, and not having any ready cash, I concluded that I would have to wind them myself. An inspection of Ye Olde Junque Boxe turned up a myriad assortment of ferrite slugs, phenolic forms, and magnet wire, scrupulously gleaned from the innards of defunct TV and BC sets, and hoarded against a rainy day. However, a subsequent examination of the common radio handbooks gave no indication of the proper proportions in which to combine them. Other experimenters in my predicament had apparently been content to hole up in the shack with a GDO and some wire until they haphazardly chanced upon a combination that worked. Experimenter oriented literature on the whole subject is practically nonexistent, and the dearth of theoretical knowledge, design data, and practical construction techniques, seems to have limited amateur efforts strictly to cutand-try for which I have a violent distaste. I'm a designer, not an experimenter! When I build a project, it works right the *first* time! Well, would you believe the second time? How about the thirteenth?

At any rate, research in the handbooks on the basic properties of inductance, plus a little benchwork, resulted in what seems to be a fairly simple, predictable procedure for designing slug-tuned coils. Only a little math is needed, and it's just simple algebra. The hard work is sidestepped through the use of a chart. The only materials required are a pencil and scratchpad (a slide rule helps if you can use one, but it's not absolutely necessary), some ferrite slugs, matching coil forms, and magnet wire, all of which should be included in any junkbox worthy of the name. (Well, you can buy it, if you really must!) All set? Let's get started . . .

Ferrite cores and permeability

The heart of a high-Q variable inductance coil is the ferrite core itself. It is available in a variety of shapes and sizes, ranging from the familiar gray, cylindrical slugs to rods, bars, tubes, and such esoteric forms as toroids and cup-cores (for special applications where a coil's magnetic field must be self-contained). Although commonly and collectively referred to as "ferrites," such cores are not solid iron, nor are they all

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alike. Rather they are compounded of varying proportions of metals such as nickel, iron, manganese, molybdenum, zinc, or their oxides, depending upon their manufacturer and intended application. The rods, bars, tubes, toroids, and cup-cores, are usually used for fixed inductances; while the cylindrical slugs, in conjunction with a phenolic or ceramic coil form, are used for variable inductors, adjustable by a brass screw around which the core is cast, or by use of threads molded into the core itself.

The characteristic which makes ferrite cores suitable for compact variable inductances (and the basis of the design procedure) is their permeability, denoted by the Greek letter μ (mu). Given a coil of fixed dimensions, with a removable ferrite core, permeability may be defined as the ratio of the coil's inductance with the core completely inserted, to its inductance with the core completely removed (that is, when the core material is air). This relationship may be expressed mathematically as

$$\mu = L_{core}/L_{air} \tag{1}$$

If, for example, a coil has a normal aircore inductance of 2.5 µH, but increases to 10 µH when a ferrite core is inserted into it, the permeability of the core is $10\mu H/2.5$ $\mu H = 4.0$. The significance of the formula is that it also works in reverse. If a coil designed to have a normal inductance of 2.5 μH is wound on a core with a permeability of 4.0, its inductance is thereby increased to 4.0 x 2.5 μ H = 10 μ H. In other words, it is possible to increase an inductance by a factor of μ without increasing its physical size merely by winding it on a high permeability core.2 This is readily apparent if equation 1 is transformed to yield

$$L_{core} = \mu L_{sir} \qquad (2)$$

Designing fixed inductors

Equation 2, plus the standard coil-winding formula³, $L = \sqrt{(rN)^2/9r + 10l^{-4}}$, are the only ones needed to design fixed-value ferritecore inductances. To show how, let's try an example:

Suppose we want a 45 µH inductance, and we want to wind it on a core with $\mu = 3.0$. Dividing 45 by 3.0, we find that what we really need is a coil with an air-core inductance of only 15 µH, so that when we wind it on the core, the core's permeability will multiply it to full value. Knowing this,

we then turn to the coil winding formula to find its physical dimensions. Before we do however, there is another factor to take into consideration: in order to get the maximum effect from the insertion of a ferrite core into a coil, the length of the core should equal the length of the coil, and the coil diameter should be such that the core just fits snugly within it. Thus, if the core in this case is 1" long by "in diameter (0.125" radius), these should be the dimensions substituted into the coil-winding formula. Making the substitution, and solving for the proper number of turns, we find

$$N = \frac{\sqrt{L(9r + 10l)^{-1}}}{r}$$

$$= \frac{\sqrt{15(9 \times 0.125 + 10 \times 1)^{-1}}}{0.125}$$

52 turns

To simplify matters, let's also assume that the coil will be closewound; thus, given the length of the coil (1") and the required number of turns (52), and dividing one by the other, we find that we need to pick a wire gauge yielding 52 turns per linear inch. A wire table shows that #25 enameled, at 51.7, will do quite nicely. The final result, then, is that we may obtain a 45 µH coil using the given slug (1" x %", $\mu = 3.0$) by closewinding 52 turns of #25 enameled wire on the slug.5

In a similar manner, specifications for any coil, using any cylindrical core, may easily be determined.

Determining permeability

So far, so good-if you know the permeability of the core material you want to use. But, suppose you don't? Unfortunately manufacturers rarely imprint slugs with a designation of μ , so what happens if you fish a typical, unlabeled, gray slug out of Ye Olde Junque Boxe?

There are two methods to determine permeability, one using an inductance bridge, and the other, a bit more involved, using an rf signal generator (a GDO, LM or BC-221 Frequency Meter, or any other calibrated, variable rf source will do as well) and a few other items we'll come to in a moment.

Using the bridge method, one first winds a test coil. Its inductance is not critical, but its dimensions are. As noted previously, it should be just as long as the core under

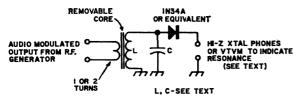


Fig. I Test circuit to determine core permability. Measure resonant frequencies with core inserted and withdrawn.

test, and just wide enough that the core fits snugly within. Measure the value of the coil's inductance, first with the core in the coil, and then with the core removed. Substitute the values of these measurements into equation 1, and divide to find μ .

Using and understanding the rf generator method entails a little math, and the construction of a test circuit. First the math: from the standard formula for the frequency of a resonant circuit, we know that

$$f = \frac{1}{2}\pi\sqrt{LC^{-1}}$$
 (3)

So, given a tuned circuit in which the capacitance remains constant, and using an inductor with a removable ferrite core, one can divide out the 2π and \sqrt{C} terms and simplify to show that

$$(f_{\text{sir}}/f_{\text{core}})^2 = \mu \qquad (4)$$

This tells us that, by measuring the resonant frequencies of a tuned circuit with the core under test both in and out of the tank coil, and squaring the ratio of the latter value to the former, permeability can be found.

In practice, such measurements can easily be made with the crystal detector test circuit of Fig. 1. As illustrated, a modulated rf signal is fed from a generator to a resonant circuit LC, via a one or two turn coupling link. Since we are only concerned with the ratio of two frequencies rather than the frequencies themselves, the values of L and C are not particularly critical as long as they are resonant somewhere within the frequency range of the generator, and the previous comments about L's dimensions are noted. With everything connected, measure the resonant frequencies of the circuit with the core both in and out of the coil, using the diode detector and earphone to indicate the point of maximum signal. The earphone should be a high-Z crystal unit, so as not to load the tank. (A VTVM could be used in its place, but the earphone is almost as accurate, far more sensitive, and much cheaper). Substitute the measured frequency values into equation 4 to find μ .

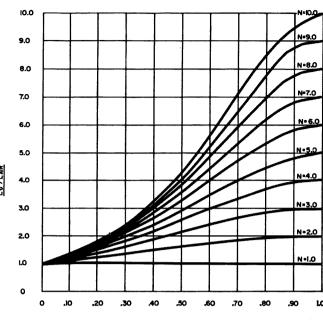
Designing variable inductors

Since the principal application of cylindrical ferrite cores is to slug-tuned coils, let's see how to design one. As with fixed inductors, the problem is one of starting with a known "target" value of inductance, a slug of known size and permeability, and being able to find an equivalent value of air-cored inductance which may be wound using the standard coil-winding formula. However, in this case, a new factor enters the picture.

It should be apparent from the previous sections that when a slug having a permeability of μ is inserted into a coil with an aircore inductance, Lair, the total inductance of the combination then becomes \(\mu \) Lair = Lcore. Lcore and Lair are the coil's two extreme values, obtained with the core completely within or completely outside it. Obviously, then, if the core were inserted into the coil only partially, its inductance would be somewhere between Lair and Lcore. With the core further in, it would be closer to Lcore, and with the core further out, it would be closer to Lair. In designing a variable inductor, the target value of inductance should fall somewhere between these two extremes, so that the coil would be properly tuned, only when a certain fraction of the core were located within it. Assuming that the coil and core are of equal length, the target value is usually obtained when the core is half in, and half out of the coil.

Thus the main problem in designing a variable inductor is one of finding an equivalent Lair such that a target value of inductance (which from now on, we'll designate as L_o) may be achieved when a core of known permeability has a certain fraction of its length (c) inserted into the coil. The solution to the whole matter is made as painless as possible with the aid of the graph of Fig. 2. This graph, along with the equation from which it is derived (included for the interest of mathematically-minded readers) is the result of the author's research aimed at determining the relationship between these factors.6 The graph shows the variation of an inductance L. as a function of it's inserted core fraction c, between values of Lair and Leore corresponding permeabilities between 1 and 10. It is malized" (in that the value of Lair is always considered to be 1.00, and values of L. are indicated as multiples of it) so that it may

Fig. 2. The inductance variation of a permeability-tuned coil as a core is inserted into it. The equations used in the preparation of this graph are given in the appendix at the end of the article.



C (FRACTION OF CORE WITHIN COIL)

be used to design coils of any particular inductance value by means of ratios. To see how it works, let's take an example:

Suppose we want to design a coil which will have an inductance of 20.0 µH when a core is inserted half-way into it (c = 0.500), and the permeability of the core we wish to use is 9.00. Find the point on the graph's horizontal axis corresponding to c = 0.500, and move directly upward to intersect the curve marked " $\mu = 9.00$ ". Then move directly across to the vertical scale and read off the multiple of Lair corresponding to the point of intersection. In this case it is 4.00. This tells us that when a slug with $\mu = 9.00$ is inserted halfway into a coil, the resulting inductance is always 4.00 times the coil's air-core value.7 The next step is to take the reciprocal of this multiple and multiply it by our target value; that is, if Lo/Lair = 4.00, then conversely, $L_{a1r}/L_o = 0.250$, and the equivalent air-core inductance we're looking for is equal to 0.250 x 20.0 μ H = $5.00 \, \mu H$.

Having found Lair, we're over the major hurdle, and the rest is downhill. As in the design of fixed-value inductors, it consists of noting the length of the slug, the diameter of the coil form, and making the appropriate calculations with the coil-winding formula and a wire table, to find the proper number of turns and wire. In a similar manner, Fig. 2 can be used to design coils of other values. Should it be desirable that the target inductance occur at some inserted core

fraction other than ½, simply locate the corresponding value of c on the horizontal and use it to find the intersection point on the appropriate permeability curve. Likewise, to use a core with a permeability other than 9.00, simply intersect the curve corresponding to the new value. The graph is plotted for integral values of μ between 1 and 10 (the range of most junkbox slugs). Fractional values may be interpolated from these, but the ratio Lair/Lo for μ greater than 10 must be calculated directly from the accompanying equation.

Accuracy

The procedures and data presented here are intended to help provide a systematic basis for further amateur research on inductance; they could be greatly refined in many ways, and by no means represent an exhaustive survey of the possibilities of ferrites. Three limits to their accuracy should be noted in particular; first, in the case of variable inductors, is the graph of Fig. 2. While it greatly simplifies calculation, it is only accurate within about 5%. Second is the limit within which the core permeability is known. Without laboratory quality instruments, or well-calibrated test equipment, it is difficult to reduce measurement errors to less than 5-10%. Third, the entire procedure is limited by the accuracy of the coil-winding formula, which is, in itself, only an approximation. While it is normally considered to be reliable within 1%, it becomes increasingly inaccurate as the ratio of a coil's length to diameter approaches 1, or as the wire diameter becomes an appreciable fraction of the coil diameter. The overall accuracy will usually be within 10-20%-sufficient for most amateur work—but don't expect miracles; accurate results demand accurate data.

Suggestions for further research

This article has been prepared in the hope of stimulating further amateur experimentation and development, to help meet the need noted in the introduction. The commercial applications of ferrites have become increasingly widespread as professional designers have begun to learn their characteristics and realize their tremendous potential. Unfortunately, little of the knowledge thus gained has as yet filtered down to experimenters in simplified, semi-technical form, applicable with a minimum of advanced math. How, for example, can one determine the method of winding a ferrite coil so that it tunes linearly-such as one for a VFO? Or, consider the problem of designing a coil using a brass slug; it's been done, but how? How does one design a toroidal coil? Is there a simple, predictable method of designing self-resonant coils for VHF? Any solutions a curious ham can find for these, or other inductance problems, would be welcomed by the rest of the fraternity, and 73 would certainly like to hear about them.

In the meantime, here's enough information to get you started, so what d'ya say we get out those slide rules, scratchpads, soldering guns, and *design* some coils!

Appendix:

Equation:
$$\frac{L_{a1r}}{L_o} = \left[(1 - \frac{1}{\sqrt{\mu}}) (1 - c)^2 + \frac{1}{\sqrt{\mu}} \right]^2$$

If $c = \frac{1}{2}$, the equation simplifies to:

$$\frac{L_{air}}{L_{o}} = \frac{(\sqrt{\mu} + 3)^{2}}{16\mu}$$

Note: Valid only for cylindrical, linearly-wound coils, whose dimensions equal those of the core being used.

- 1. The approaches to be outlined above were developed independently, as part of a high school physics research project, and have not, to my knowledge, appeared elsewhere in print. If, however, I should happen to infringe on previously published material, I apologize, and would be pleased to acknowledge it.
- 2. And, therefore, as previously noted, the dc resistance per unit inductance is reduced, and the Q, its reciprocal, is raised.
- 3. Only single-layer, cylindrical, linearly-wound coils are considered here, since they are the ones most often encountered in amateur work. For multi-layer, progressively-wound, or other kinds of coils, the appropriate winding formulas should be used instead.
- 4. L is the coil's inductance, in μ H; r, its mean radius (in inches); N, the number of turns; and l, its length (also in inches).
- 5. Practical tip: hold the windings in place with coil dope or Duco cement.
- 6. Readers interested in the mathematical development of the above equations, or the derivation of Fig. 2, should write to me, enclosing a sase; if there is enough demand, I can prepare a mimeo sheet detailing the process.
- 7. Note again, that the graph is valid only for singlelayer, cylindrical, linearly-wound coils, whose dimensions correspond to those of the core.



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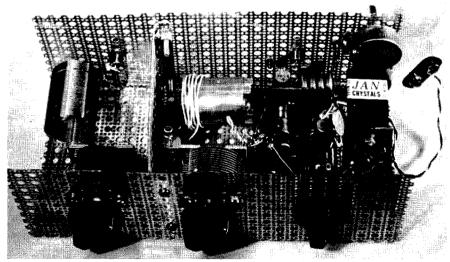
An FET Converter for 40 and 160

If you have been looking for a way to listen in on 160 meters, here's a converter for 160 and 40 which feeds into an 80-meter tuner. The 40-meter coverage is ideal for the novice whose equipment limits him to 80 meters.

In a previous article¹, the author described a 10-20 meter FET converter which was to become part of the front-end of a 10-160 meter transistorized receiver. The results were sufficiently encouraging to warrant building a modified version, covering 40 and 160 meters. Eventually, the two converters will be combined with an 80 meter FET tuner, which is still in the breadboard stage, for coverage of the six high-frequency amateur bands.

Design

The converter schematic is shown in Fig. 1. A Motorola 2N4224 is used as the rf amplifier, while an MPF105 is used as the mixer. The local oscillator is a 2N1180. An attempt to use an MPF105 as the rf amplifier resulted in an unstable stage. Perhaps more attention to lead length and dress would have tamed the stage, but this was not investigated. A pair of 1N100 diodes is con-



Top view of the FET converter for 40 and 160 meters.

Photo by Joe Cohen

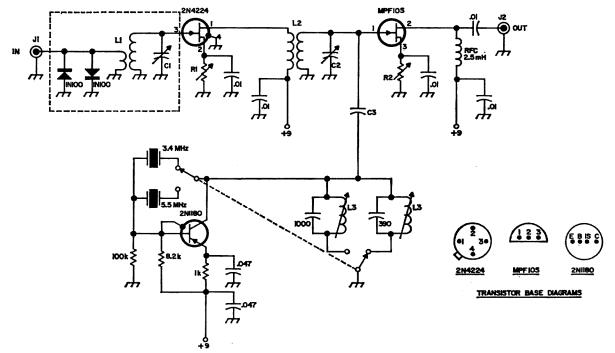


Fig. 1. Schematic diagram of the 40 and 160 meter converter. Field effect transistors are used in the rf amplifier and mixer stages, a bipolar device in the crystal-controlled oscillator. Tuned circuit values are given in Table 2.

nected across the converter input to prevent excessive rf voltages from being applied to the 2N4224 while transmitting.

While there is some question as to the need for an rf amplifier at frequencies below about 10 MHz, one was included, principally to minimize local oscillator radiation by way of the antenna. However, if the converter is to be used with an *if* other than 80 meters (as described later), an rf amplifier may be helpful in reducing image response, depending on the *if* chosen.

The difference between the 10-20 and 40-160 meter converters lies in the rf amplifier, mixer, and local oscillator tuned circuit constants and the local oscillator injection frequencies. The values shown in Fig. 1 are appropriate to tune the rf amplifier between 1.8 and 7.3 MHz and to provide the injection frequencies required to heterodyne 40 and 160 meters to 80 meters. With the crystals specified, 160 meters is tuned between 3.7 and 3.5 MHz, and 40 meters is tuned between 3.7 and 3.9 MHz on the

80 meter if. Note that if 7.0 MHz is hetrodyned to 3.5 MHz, and the 40 meter band is to be tuned "frontwards", an injection frequency of 3.5 MHz is required, and the local oscillator will interfere with reception on the low end of the band.

Use with if's other than 80 meters

For several weeks the 10-20 and 40-160 meter converters were used with a BC-453 as the station receiver at K6DQB. The hookup used is shown in Fig. 2. In this case, an extra crystal(s) is used and 80 meters, as well as 40 and 160 meters is heterodyned to the if tuning range of the BC-453 - 220 to 550 kHz. The 80-meter range of the lowfrequency converter is used as the if for the high-frequency converter for 10-20 meter reception. A table of local oscillator coil and crystal requirements is shown in Table 1. With the injection frequencies shown, coverage of 10 meters is incomplete. Two additional crystals, 3.9 MHz in the low-frequency converter, and 25.5 MHz in the high-fre-

Fig. 2. The two converter—BC-453 receiving arrangement. The 10, 15 and 20 meter converter was described in the May issue of 73.

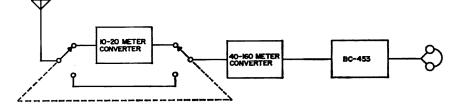


Table I Local oscillator coil and crystal requirements for an if of 220 to 550 kHz

Frequency Range	Oscillator Coil	Tuning Oscillator Padder Capacitor	Injection Frequency
7.0 - 7.3 MHz	15 turns	330 pF	6.8 MHz
7.3 - 7.0 MHz*	15 turns	330 pF	7.5 MHz
3.5 - 3.8 MHz	36 turns	390 pF	3.3 MHz
3.8 - 4.1 MHz	36 turns	390 pF	3.6 MHz
2.0 - 1.8 MHz	26 turns	1000 pF	2.2 MHz

^{*} This arrangement is recommended for the CW operator since it provides a higher if at the low end of the 40 meter band for better image rejection.

quency converter, would provide the necessary heterodyning frequency combinations required for full coverage. Since the author has not tried this, no values are specified in the table.

Results

As with the 10-20 meter converter, the results with this converter have been pleasing. In particular, susceptibility to cross-modulation appears very slight.

. . . **K6DQB**

Table 2. Tuned circuit values.

- C1, C2-15-409 pF variable (Allied Radio 43A3524)
- C3 —Two 1-inch lengths of insulated hookup wire twisted together.
- L1 —Primary, 6 turns number 24, 32 TPI, 1-inch diameter (B&W 3016). Secondary consists of 40 turns number 24, 32 TPI, 1-inch diameter, spaced one turn from primary.
- L2 —Primary, 7 turns insulated hookup wire closewound on cold end of secondary; secondary same as L1.
- L3 —25 turns number 30 enameled wire, closewound on 1/4-inch slug-tuned form (Miller 20A000RBI).
- L4 —Same as L3, except 36 turns.
- R1, R2—10 k potentiometer. Adjust for stable operation and replace with fixed resistors.

Tape Recording QSO's

After you have finished that QSO with mother ham half-way around the world, how many times have you wanted to relive it again at a later time? Thanks to the development of the modern tape recorder, this is easily done. You can wire a recorder into the station gear. Hooking it up is no real problem. Most recorders now on the market have an auxiliary input which is designed to provide a good match when recording directly from radios and record players or transcribing from other tape recorders. I have found that the best method is to tap into the input side of the volume control of the receiver and run this to the auxiliary recorder input. You can also record from the phone jack or speaker terminals, but a direct physical connection to the volume control gives better control and mobility.

Should you want to record both sides of a QSO, simply put a relay into the circuit; then you can have both transmissions on one continuous tape. Hook the relay in parallel with your antenna relay so that when you are listening the relay switches to the receiver and on transmit it switches to your monitor. I always have two receivers in my shack and

the secondary one has the antenna grounded so that by carefully adjusting the rf gain I can monitor my own signal. Make sure that all pieces of gear are well bonded together and grounded. Use shielded cable and short lengths—otherwise pickup may cause trouble with the recorder.

To play back the recorded QSO's, start by running the recorder output directly into the mike jack—impedance will vary on different rigs, but by juggling the tape output gain and the transmitter audio gain you should come up with acceptable modulation. Again be sure to use shielded lines and have all equipment well bonded and grounded. If you don't have good results, try some impedance matching coils such as those used in phone patches.

I have been recording ham radio QSO's for the past 10 years and I'm not sorry for a single foot. I have most of the rare DX and the DXpeditions of recent years on tape plus some calls that are no longer on the air. I have been fortunate in being able to ham from three continents and wouldn't trade the tape footage I have for anything.

. . . Ken Bale W7VCB/DL4IO

^{1. &}quot;A Field Effect Transistor Convertor For 20, 15, and 10 Meters", K6DQB, 73. May 1967. The reader is referred to that article for design considerations and lay-out.

West Coast VHF Antenna Measuring Contest

One of the big events at the West Coast VHF Conference in Fresno this year was the antenna measuring contest held on Sunday, May 7th. The weather all during the month of April was terrible, with a lot of rain and little sunshine, but on the conference weekend the VHF'ers were blessed with beautiful clear weather.

The turnout for the antenna contest was tremendous. A total of 47 antennas were measured, 22 for 432 MHz and 25 for 1296. This is the largest number of antennas entered at one of these events, and the contest took all day.

The antenna measuring party this year was improved considerably over past events because of a special reference antenna built by Bob Melvin, W6VSV. This reference antenna is a National Bureau of Standards design which eliminates some of the reflection problems caused by the reference dipole which is normally used.

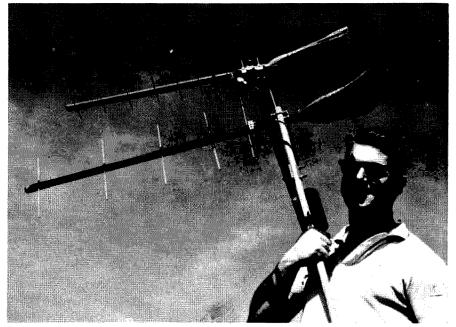
The antenna with the highest gain in the 432 MHz contest was K6MIO's 8-foot dish with a homemade extension to 12.5 feet¹; the measured gain was 16.9 dB. Next, at 16.2 dB, was K6HAA's 32-element expanded-extended collinear, originally designed by Oliver Wright, W6GD. Then, third down, was K6MIO's cylindrical parabola with a 7-dipole collinear feed² at 13.2 dB. Following the top three were several Tilton

11-element Yagi's³ measuring from 11.5 to 13.0 dB, a W2CCY Yagi at 11.0 dB, a commercial 16-element collinear at 10.3 dB, K6MIO's 7-dipole collinear feed (without parabola) at 9.7 dB, and a 14-element J slot, a 90° corner reflector, a 4-foot Lafayette UHF TV parabola with dipole feed, and a 9-element quad, all at 8.2 dB. Lower gain antennas included assorted Yagi's, a dipole of "questionable match", corner reflectors, a large half horn and a small fourfoot UHF TV dish.

The dishes led the field in the 1296 contest with WB6IAG's four-foot TV dish with ½-inch mesh at 17.3 dB, K6MIO's 12.5-foot dish at 17.1 and 16.8 dB (standard dipole and WB6IAG feeds respectively), WA6MGZ's four-foot TV dish covered with aluminum foil at 16.2 dB (16.3 dB with WB6IAG's feed), and K6HCP's four-foot TV dish with ¾-inch mesh at 15.6 dB (16.3 dB with WB6IAG's feed). It is interesting to note that WA6MGZ's dish measured only 12.4 dB when the foil was removed.

Following the parabolas were W6GD 32-element extended-expanded collinears: WA6GYD's at 14.2 dB, W6GDO's at 14.0 dB and W6BUR's at 12.8 dB. Then, K6HMS's solid aluminum horn at 11.5 dB, W6ZOP's half-horn monster at 10.1 dB, WB6IOM's 24-turn helix at 8.2 dB, K6HOU's "cleansweep" Yagi at 7.8 dB, WA6KKK's 60°

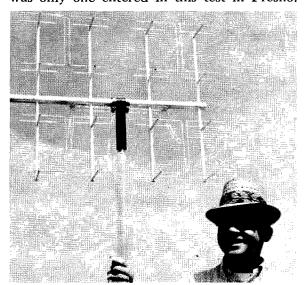




K6HOU and his "cleansweep" Yagi's for 432 and 1296 MHz. The 8-element job on top measured 7.8 dB; the 6-element unit below, 7.2 dB.

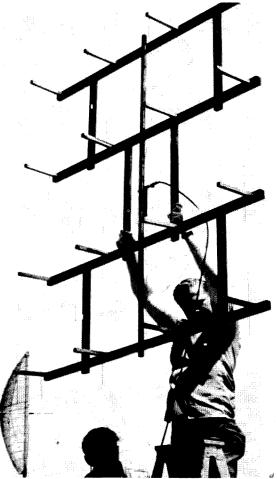
horn at 7.5 dB, and WA6NCT's zig-zag antenna, stock UHF TV antenna and coffee-can antenna at 7.0, 5.1 and 3.1 dB respectively. A brass dipole and inverted discone, both brought by W6GDO, measured -2.0 dB.

If you look at the records from the various contests down through the years, you will notice that certain types of antennas are consistent winners. On the west coast for example, the W6GD extended-expanded collinears always end up in the first few places on 432 MHz, and, they usually win. However, they are more prevalent in Northern than in Southern California, hence, there was only one entered in this test in Fresno.



W6BUR's silver-plated 32-element extended-expanded collinear measured 12.8 dB on 1296 MHz.

Since the contest rules state that the antenna must be held and aimed by one man,



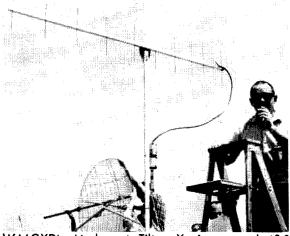
K6HAA's 32-element extended-expanded W6GD collinear measured 16.2 dB. The small four-foot dish in the background was tested at 1296.



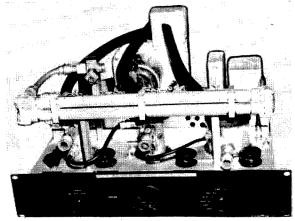
K6MIO's 12.5-foot dish measured 16.9 dB at 432 Mhz. This dish consists of an 8-foot surplus with a homemade extension which brings it out to a 12.5-foot diameter.

parabolas don't make out too well on 432. On 1296 it's a different story, since it's fairly easy to hold and aim a 20-dB dish.

After the W6GD collinears and dishes come the Yagi's, usually a good three dB down the totem pole. And, of all the Yagi's, the design by Ed Tilton, W1HDQ, seems to be the most reproduceable and consistent in gain. Some other Yagi's have done about as well as the Tilton design, but not con-



WA6GYD's 11-element Tilton Yagi measured 12.8 dB gain at 432 MHz. Note the beer-can balun and folded-dipole radiator.



Also shown at the convention was W6GDO's 60-watt SSB transmitting converter assembled from surplus DME (distance-measuring equipment).

sistently. And, to my knowledge, a Yagi has never won the West Coast affair.

There is one other interesting facet to these antenna measuring contests—the absence of commercial antennas. The reason of course is that they just don't perform as well as the homemade units on these frequencies. Usually one or two will show up at the contest, but when the dust has all settled, they are well back in the pack, and their owners go home sadder but wiser.

Although the measurements made at these antenna measuring parties are reasonably accurate, there are many problems involved. The West Coast group has conducted them for a number of years, and each year the accuracy improves slightly. This year the use of a standard-gain antenna instead of a reference dipole improved matters considerably. Next year the group is planning on using a cherry picker or mobile mast to hold the signal source about forty feet off the ground. With this type of source mounting, the test antennas can be aimed upward over the horizon at an appreciable angle, further reducing problems with ground reflections, one of the big bugaboos of measuring antenna gain. However, considering all the vagaries in measuring gain, the West Coast group has come a long way since their first contest a few years ago. This is borne out by the fact that the gain figures for the same antenna remain pretty consistent from one year to the next.

. . WIDTY

1. K6MIO, "Illumination and Parabolic Antenna Design", 73 Magazine, December 1966

sign', 73 Mayazine, December 1966 2. K6MIO, 'Big Sail for 432", 73 Mayazine, August 1965.

3. Tilton, "Yagi Array for 432 Mc.", QST, April 1966.

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This wildfire boom presents a solid gold opportunity for trained two-way radio service experts. Most of them are earning \$5,000 to \$10,000 a year more than the average radio-TV repair man.

Why You'll Earn Top Pay

One reason is that the U.S. doesn't permit anyone to service two-way radio systems unless he is *licensed* by the FCC (Federal Communications Commission). And there aren't enough licensed experts to go around.

Another reason two-way radio men earn so much more than radio-TV service men is that they are needed more often and more desperately. A two-way radio user must keep those transmitters operating at all times, and must have them checked at regular intervals by licensed personnel to meet FCC requirements.

This means that the available li-

censed expert can "write his own ticket" when it comes to earnings. Some work by the hour and usually charge at least \$5.00 per hour, \$7.50 on evenings and Sundays, plus travel expenses. Others charge each customer a monthly retainer fee, such as \$20 a month for a base station and \$7.50 for each mobile station. A survey showed that one man can easily maintain at least 15 base stations and 85 mobiles. This would add up to at least \$12,000 a year.

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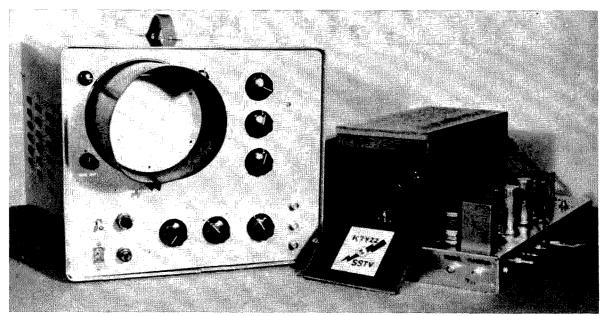
Business is booming. August Gibbemeyer was in radio-TV repair work before studying with CIE. Now, he says, "we are in the marine and two-way radio business. Our trade has grown by leaps and bounds."

A Slow-Scan Television Picture Generator

Introduction

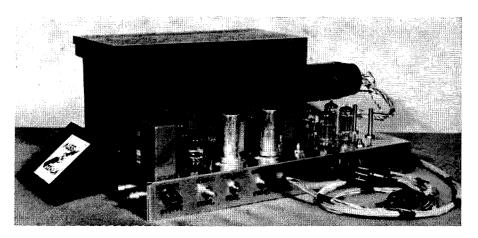
The author became interested in Slow Scan TV (SSTV), after having experimented with Fast Scan TV1, as a means to extend the range of picture transmission. The reception and transmission of SSTV was observed at Bob Gervenack's station (W7FEN) during the recent FCC authorized tests on twenty meters2. The clarity and detail of the pictures observed, considering the bandwidth of the transmitted signal, were quite impressive. In fact, the author immediately began construction of a SSTV monitor3. The monitor was completed three weeks later, and has performed satisfactorily when displaying SSTV signals received on local VHF tests. The SSTV subcarrier frequency modulated (SCFM) signal as proposed by Macdonald4, is essentially a 1500 Hz voltage controlled audio subcarrier, shifted down periodically to 1200 Hz for sync information, and then varied from 1500 Hz (black) to 2300 Hz (white) for the video information. One complete picture is sent every eight seconds.

The next step was to construct a unit which would be capable of sending SSTV pictures. Several articles describing SSTV camera equipment were reviewed.5,6,7 The vidicon camera looked interesting, but the non-availability of the special vidicon required for the unit discouraged that approach. The most feasible and easily constructed type appeared to be a Flying Spot Scanner. No article could be located which provided complete information and schematics on the construction of a Flying Spot Scanner for SSTV. The unit described in this article is based on portions of the circuits combined to provide for the generation and transmission of positive pictures and sketches.



The slow-scan television generator and monitor built by K7YZZ. Although the use of this equipment is presently limited to six meters and up, SSTV tests on 20 meters with KC4USV in Antarctica have resulted in a recommendation to the FCC that SSTV be permitted on the HF bands.

The slow-scan television picture generator. The cathode-ray tube and photo-multipliers are housed in the light-tight box on the rear of the chassis.



How it works

In the block diagram of Fig. 1, a raster is painted electronically on the end of the cathode ray tube by vertical and horizontal oscillators and amplifiers. The light from the raster is focused on the photograph to be transmitted. Reflected light from the picture is detected by the two photomultiplier tubes, and is converted into a weak de signal.

This signal is amplified by the photomultiplier tubes, and the output is connected to the modulator which shifts the voltage controlled subcarrier oscillator from 1500 Hz to 2300 Hz, depending upon the level of light falling upon the photo cells. Sync signals from the vertical and horizontal oscillators are combined in the sync mixer. and the resultant composite sync signal is connected to the modulator which shifts the subcarrier down to 1200 Hz. The horizontal sync pulse is a burst of 1200 Hz 5 milliseconds long, and the vertical sync pulse is 30 milliseconds of 1200 Hz. The audio subcarrier output is connected to the microphone input of the transmitter through the monitor.

Construction

The SSTV Flying Spot Scanner is constructed on two chassis for ease of handling and to keep the power transformer magnetic field as far away from the cathode ray tube as possible. The five-wire cable supplies power to the cathode ray tube filament and high voltage. The six-wire cable supplies filament and low voltage to all other tubes.

The electronics portion of the unit (Fig. 2) is mounted on a 10" x 17" x 2" aluminum chassis. The box containing the photocells, lens, and cathode ray tube is 6" x 12" x 5½" and is constructed of 3/16" thick mahogany. The inside is sprayed with dull black acrylic paint. A small door, 5" x 5½", is fitted in the end opposite from the cathode ray tube face. Two small metal clips were fabricated and mounted on the inside of the door to hold the photograph as it is being scanned by the light beam.

An aluminum divider (painted dull black), to hold the lens and seal the photocell compartment from the cathode ray tube compartment, was constructed so that it would just press fit between the two box

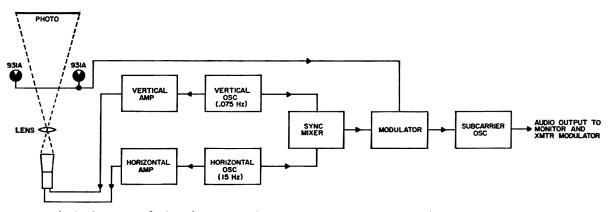
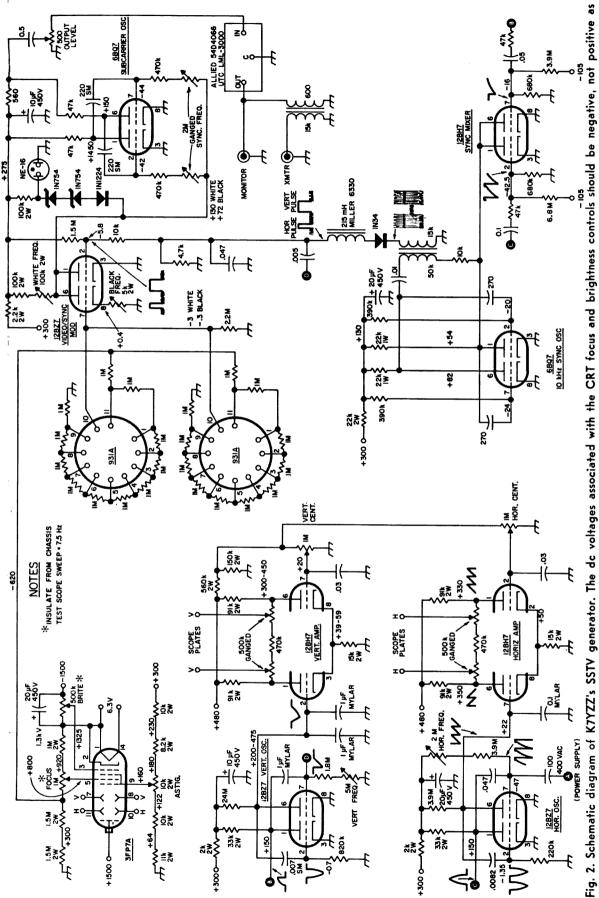


Fig. 1. Block diagram of the slow-scan television picture generator built by K7YZZ.



shown. The 50k:15k transformer in the plate circuit of 68Q7 10 kHz sync oscillator is a Knight 54D1458. The 600:15k output transformer in the transmitter line is a Knight 54D2023.

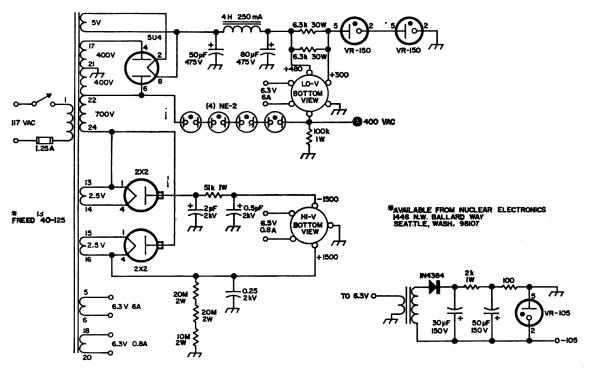


Fig. 3. Schematic diagram of the power supply for the SSTV generator. Watch the filter capacitors in the negative supplies—their polarity is reversed.

side walls. The lens originally used was installed on a home made fast scan vidicon camera. It is a F1.9, 48mm lens, and is available from Denson Electronics, Rockville, Connecticut. Their part number—3800 (lens) and 3801 (mounting ring).

The two photocells are mounted on %" metal standoffs which are located on each side of the lens assembly, just forward of the aluminum divider. A piece of masking tape, 1" x %" is taped over the photocell window (grid wire), and the tube is sprayed with dull black paint. When the paint is thoroughly dry, the masking tape is removed to expose the window. The photocell is mounted to that the window faces the photograph on the door. The bottom for the wooden box is provided by the aluminum chassis. That portion of the chassis covered by the box is painted dull black.

The wiring of the unit is not tricky as the highest frequency is only 2300 Hz. Wiring practice applicable to hi-fi audio work is satisfactory.

Adjustment

Typical voltage and waveform data are shown on the schematics. The raster on the 3FP7 was adjusted to a square format approximately 1¼" x 1¼". The 3FP7 is mounted so that the high voltage contact

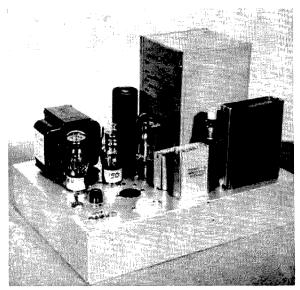
button on the side of the tube is at the top. Connections to the vertical deflection plates provide for a sweep from bottom to top, and the horizontal deflection plates are wired to give a sweep from right to left, as viewed on the 3FP7 tube face. The metal divider holding the lens may be moved to provide a rough adjustment of optical focus of the beam on the photograph, and fine focus is provided by the lens assembly mechanical focus system.

Sync frequency adjustment is accomplished by grounding pin #2 of the 12BZ7 video/ sync modulator, and adjusting the sync frequency control so that the subcarrier oscillator output is 1200 Hz. Remove the ground from the #2 pin.

The black frequency is set by turning the 3FP7 brightness control down, until the raster fades out. The box is closed with no picture on the door. The black frequency control is adjusted so that the subcarrier oscillator output is 1500 Hz.

An all white card is now placed on the door, and the door closed. The 3FP7 brightness is advanced slowly, until a bright raster is painted on the face of the scope tube. The white frequency control is adjusted so that the subcarrier oscillator output is 2300 Hz.

All surplus 931-A photo tubes may not have equal sensitivity. Out of four tubes



The power supply for the K7YZZ slow-scan television picture generator.

tested by the author, one was quite weak, another very sensitive and the remaining two were of average sensitivity. Their sensitivity was determined by plugging them in one at a time and observing the resulting light pattern on the monitor, with no change in the 3FP7 brightness control after initial adjustment. If two tubes of near equal sensitivity cannot be obtained, the negative voltage to the more sensitive tube will have to be reduced to keep the gain of both tubes equal.

It has been found that messages or drawings, made with black ink marking type pens on a white matte finish paper, make fine test prints. Glossy photographs, such as Polaroid camera shots, are satisfactory but the shiny, slick finish may cause a light burn on parts of the reproduced pictures as seen in the monitor, unless the photograph is treated with a glare reducer such as "Krylon Dulling Spray" No. 1310.

Miscellaneous

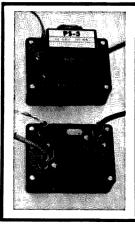
The low-pass audio filter in the output of the subcarrier oscillator was added to restrict the bandwidth of the system when used with a SSB transmitter. The multivibrator subcarrier oscillator is rich in harmonics, which would cause undue interference on our crowded HF bands. A more economical type of low pass filter, designed around the readily available 88 mH toroids, may be substituted.

Although at the present time, the general use of SSTV transmission is limited to the six meter band and up, the FCC has authorized special testing of SSTV in the amateur service on the 40, 20, and 15 meter phone bands. The tests will be conducted between KC4USV, Antarctica, and suitably equipped amateur stations in the Continental United States. It is hoped, in the not too distant future, that complete authorization for general use of SSTV on the HF bands will be given. In the meantime, now is the time to get the equipment built and tested.

The author wishes to thank Bob Gervenack, W7FEN, and Copthorne Macdonald, WAØNLO, for their technical support in this project.

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VHF Log-Periodics and the "Log -Scan 420"

If you have been planning an antenna system for the VHF or UHF bands, you shouldn't overlook the log-periodic array. This antenna features high gain, wide bandwidth and reproduceability.

The new look in antennas is here. Soon VHF log-periodic antennas will be replacing yagi arrays of practically all types, and also replacing old standbys such as the collinear, helix, and corner reflector. This revolution has already been taking place in the television antenna business for several years and there are good reasons why.

First of all, do not be led astray on the subject of gain. Not many people interested in antennas presently know that log-periodics having about 1.5:1 bandwidths can deliver just as much gain as yagis the same size and having only a few percent bandwidth. This, as well as other new data, has been accumulated in the last few years and the properties of the planar (flat) log-periodic have been under investigation recently. Only lately has it become evident that log-periodics with small apex angles can yield as much as 12 dB gain.

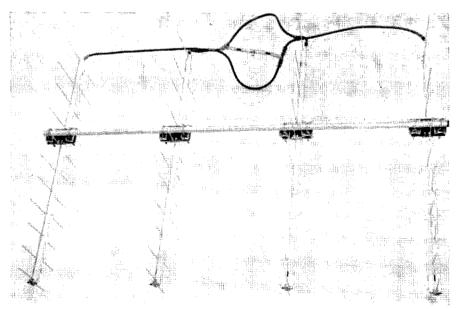
Construction details of the "Log-Scan 420" are presented later in this article. This an-

tenna serves as an excellent example of the advantages of the log-periodic. Here is a summary of its characteristics:

- a. Gain: 16-17 dB over an isotropic.
- b. Bandwidth between 1.5:1 SWR points: 50 MHz.
- c. Size: 144" wide, 65" high, 41" deep.
- d. Input impedance: 50 ohms unbalanced.
- e. Matching section or tuning adjustments necessary after construction: none.

As you can see, the antenna is ideal not only for general work on 420, but is just the thing for the ever-growing amateur television fraternity. Let's compare it with its nearest competitor, the yagi.

A stacked array of four yagis of the same overall size would have 1.5 λ length booms, seven to nine elements per yagi, and each yagi would exhibit about 11 dB gain. With a stack of the above dimensions, a gain increase of only 4-5 dB would result because some aperature overlap occurs. However, even with fullwave stacking (height of 80"),



The "Log Scan 420" array built by K4GYO. Each antenna in this array exhibits about 11.5 dB gain; the entire array yields about 17 dB.

a total array gain of over 16.5 dB is unlikely. Advantage of the yagi in gain: little or noth-

ing.

Mechanically, the yagi has the advantage of fewer booms and elements, but from every other standpoint, the log-periodic array has the upper hand. For instance: a 50 MHz bandwidth, compared to a 1 to 2 MHz bandwidth of the yagi. Even with special techniques, bandwidth of more than 10 MHz for the yagi array cannot be achieved without going to twin- or triple-driven elements at the expense of array size and/or gain. Also, log-periodics are not sensitive to tuning effects caused by element and boom diameter. Nor do small (less than 2%) variations in element lengths from those intended have much effect on gain and input impedance. In addition, no balun, delta, tee or gamma match is needed to couple the antennas to the coax phasing harness or feed line. The log-periodic design can be adjusted to provide a good match directly to coax of any impedance; this eliminates any tuning or pruning, and effectively reduces the weatherproofing problem to zero. More about these factors later.

What advantages does the planar log-periodic offer over dishes and corner reflectors? One word: size. The "Log-Scan" has the gain of a dish 7 feet in diameter, or of any other screen reflector antenna of about the same area. It also has about the same gain as a 32-element collinear 62 inches square. The reason is that, like the yagi, the traveling-wave structure of the log-periodic multiplies the effective capture area it exhibits, to equal a reflector antenna of much larger size (whose capture area approximately equals the reflector area). The simplicity of transmission-line matching doesn't offer too much advantage over the dish or corner reflector, but does when compared to the problems encountered with a 32-element collinear in a high humidity area.

Designing your own

Log-periodics have the extraordinary feature of being truly wide-band structures, with their electrical properties repeating at intervals occuring at a ratio equal to the factor τ , as the frequency is changed. The τ factor is the factor by which the next higher set of elements on the antenna decreases in length, relative to any one set. If, for example, an array had a τ factor of 0.9, and the longest set of elements were 100 inches

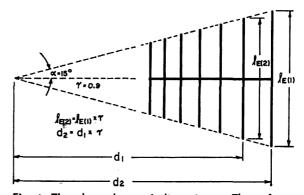


Fig. 1, The planar log-periodic antenna. The τ factor determines the relationship between subsequent element lengths and spacing. The α angle is the apex half-angle shown here. Both of these factors control the available gain of the array.

long, the second set would be 90 inches, the third set, 81 inches, and the fourth set, about 73 inches. The τ factor is usually chosen above 0.7 so the properties of the antenna repeat close enough together percentage-wise so there is no appreciable variation in them. A log-periodic can be made to cover 10:1 frequency ranges or more. However, to cover, say, a 100:1 range, it would be necessary to scale down the diameters of the elements and booms in inverse proportion to the increase in frequency.

The low cutoff frequency occurs when the *longest* set of elements is about 0.47 wavelengths long. The high cutoff frequency occurs when the *shortest* set is about 0.38 wavelengths (for that frequency). If it is desired to maintain gain and pattern closely over all of a given band, the cutoff frequencies should be set 10% below and above the band limits for τ factors of 0.9 and above; 20% for smaller factors.

The α angle is the apex half-angle, as shown in Fig 1. The τ factor and α angle together control the available gain; it being higher for a smaller α angle (which means a longer boom) and a higher τ factor (which means more sets of elements).

It can be seen why an antenna can be duplicated with different element and boom diameters than the original, without affecting the performance. All that will happen is that the high and low cutoff frequencies will be shifted slightly. This factor makes building log-periodics much easier than building and adjusting vagis.

Looking at Fig. 2, it can be seen that the planar log-periodic is actually a balanced transmission line with elements fed from along its length. Notice that each set of

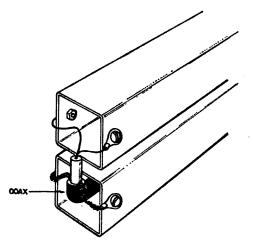


Fig. 2. Method of feeding the log periodic with coaxial feedline. The coaxial line is fed through one of the booms and connected to both.

elements is reversed in feed polarity from the previous set. The antenna will not work unless this is done. The antenna structure is fed at the high-frequency end, and its feed impedance appears somewhat less than the characteristic impedance of the boom structure. It is possible to match impedances from 50 ohms to 200 ohms by adjusting the boom spacing. The only restriction is that low impedances should be used only with high τ factors, although the reverse isn't true.

The L-P balanced structure can be fed by coax, without using a separate balun, by feeding the coax through one of the booms from the back of the antenna. The shield of the coax is connected to the carrier boom only at the very front, and the center conductor is connected to the end of the other boom by the shortest possible path. Currents on the other surfaces of the booms drop almost to zero toward the rear of the antenna, and the boom completely shields the coax from antenna fields along its length. The coax can be taken from the rear of the boom to the mast at about a 45 degree angle, without producing noticeable effect on antenna pattern, or line SWR. Notice that both booms must be insulated from the support mast and should be spaced from it by at least twice the gap between the booms.

It should be kept in mind that the smallest possible booms should be used for building VHF arrays, because this will lessen the amount by which the halves of an element set are out of line with each other. The fact that the halves are not directly in line causes some shift in polarization away from horizontal. This can be minimized by using high

 τ factors and by using square booms with the elements inboard toward each as far as possible. This was done in the "Log-Scan" (see Fig. 9)

The gain is related to the α angle and τ factor as shown in Fig. 3 on the left scale. Antennas will work with other combinations of α and τ , but these combinations are optimum for maximum gain. Fig. 3 also allows estimates of the size of an antenna for a given gain and bandwidth.

Let us design a L-P array as an example. Suppose that you wanted to build a fairly high gain L-P to cover 144-225 MHz, including 2 meters, channels 7-13, and 1½ meters. The antenna is to have as much gain as possible without exceeding a boom length of 10 feet (l_B) . First, calculate how many wavelengths at 144 MHz are equal to 10 feet:

 $n = l_B \times f_{lower}/985$

 $= 10 \times 144/985 = 1.46$

Then calculate the bandwidth ratio, BW: $BW = f_{upper}/f_{lower} = 225/144 = 1.56$

Then, going to the graph, draw a straight line from 1.56 on the right scale, through 1.46 on the center scale, and find its intersection on the left scale. Roughly, $\alpha=4.5$ degrees and $\tau=.95$. The gain available is 11.5 dB. This gain is equivalent to a 2-meter yagi of the same length, with a typical bandwidth between 1.5:1 SWR points of 2 MHz—not even enough for the whole amateur band!

The next step is to calculate the longest element length. This length, l_{E1} , is equal to 0.47 at the lower cutoff frequency:

 $l_{\text{EO}} = 0.47 \text{ x } 985/f_{\text{lower}}$

 $= 0.47 \times 985/144 = 3.22$ feet

The second set of elements has a length of: $l_{\rm E(2)} = l_{\rm E(1)} \times \tau$

 $= 3.22 \times 0.95 = 3.06$ feet

The rest of the element lengths are calculated in turn by multiplying each length by τ to obtain the next length. To know how many sets are needed, calculate the ideal shortest element, $l_{E(t)}$; equal to 0.38 τ at the high cutoff frequency:

 $l_{\text{E}^{(n)}} = 0.38 \text{ x } 985/f_{\text{upper}}$

 $= 0.38 \times 985/225 = 1.66$ feet

Then continue the original table of elements until a length of less than 1.66 feet is reached. This is the shortest element needed (don't necessarily use 1.66 feet).

To determine the location of each element, start by determining the distance diffrom the longest (and rearmost) element,

to what would be the apex if the frequency coverage extended to infinity (see Fig. 1):

$$d_1 = l_{E(1)}/2 \text{ x cotangent } (\alpha)$$

(where $\alpha = 4.5^{\circ}$)
= 3.22/2 x 12.77 = 20.59 feet

The second element will be a distance da from the apex:

$$d_2 d_1 x \tau$$

= 20.59 x .95 = 19.55 feet

The table is continued, the same way as the element length table was, until finished. The last distance subtracted from 20.59 feet gives the exact boom length needed, except for adding perhaps a half inch at each end to hold the end elements. This won't be exactly 10 feet, but can be adjusted by changing τ a small amount and recalculating both distances and element lengths.

Next, choose a transmission-line impedance. If, for example, you decide on 50 ohms, a value of about 60 to 100 ohms should be tried for the characteristic impedance of the boom structure. The spacing will be much less than the boom width in this case. Decide what the smallest boom diameter is that is practical to use, and, fit your coax through. For circular booms, the approximate spacing can be found from a table in most handbooks showing the characteristic impedance of parallel-wire lines as a function of relative spacing. If square booms are used, you may have to guess a little, because, as vet, I haven't been able to find a formula for the impedance of square-conductor transmission lines. I have found by experiment that spacing of about 20% of the width of a square boom, gives a characteristic impedance close to 50 ohms for the finished antenna.

If it is desired to stack a pair of the antennas such as just designed, the coax should have impedance close to 100 ohms (91 ohms), and the boom structure should end up being between 110- and 180-ohm characteristic impedance. The coax cables are then brought out equal distances from the rear of each boom, and joined in a tee connector. The lengths of the individual cables are unimportant, so long as they are equal, in order to maintain proper radiation phasing. At this junction, the feed impedance will be close to 50 ohms. This combining method is, of course, frequency-independent and can also be used with three or four stacked antennas if 150 or 200 ohm coax can be obtained (those available may be relatively lossy). All feed lines should be the same

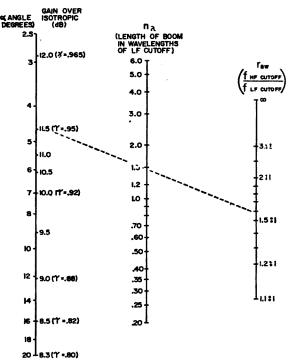


Fig. 3. Design nomograph for log-periodic antennas. When the bandwidth ratio is known ($f_{\rm hf}$ cutoff/ $f_{\rm lf}$ cutoff/, the length of the boom, α angle and gain over an isotropic can be found. For example, for an L-P for 144 to 225 MHz, the bandwidth ratio is 1.56. A boom is available which is ten-feet long (1.46 λ at 144 MHz). What α angle and τ factor are required? The dotted line indicates an α angle of 4.5 degrees and τ factor of 0.95; gain is approximately 11.5 dB.

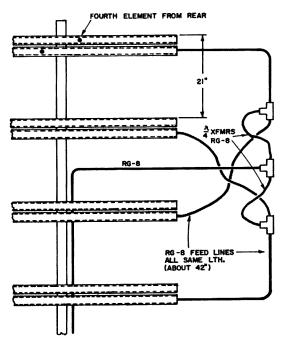
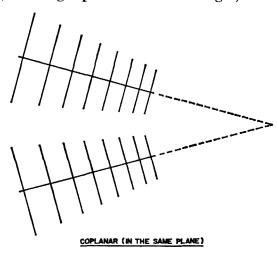


Fig. 4. Feed harness for four stacked log-periodic antennas using RG-8/U coaxial cable.

type, exactly the same length, and should all be hooked in parallel at the same point. The formula for paralleled resistors gives the driving impedance at this point.

With L-P arrays designed for less than 20% bandwidth, ¼-wave matching transformers can be used instead of the above method. The "Log-Scan" has all four L-P sections adjusted for, and fed with, 50-ohm coax. Then the feed lines are tee'd together in two pairs, as shown in Fig. 4. The resulting two impedances of 25 ohms are fed through ¼ wave, 50 ohm transformers to obtain two 100 ohm impedances. These are paralleled again in a third tee, getting us back to 50 ohms again.

The stacking of L-P's and the results obtainable are fairly similar to the stacking of yagis. With L-P's having less than 20% bandwidth, all sections can simply be made parallel to each other and spaced according to the same considerations found to apply when stacking yagis. The original "Log-Scan" employs % wave stacking distances (some might prefer a full wavelength). When



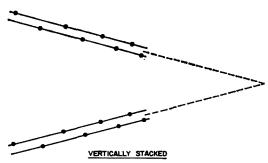
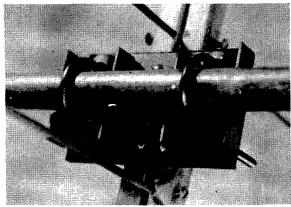


Fig. 5. Method used for stacking log-periodic antennas. Note in the vertically stacked drawing that each set of elements in the antenna are reversed in feed polarity from the opposite set.



Method of mounting the individual "Log Scan 420" log-periodic antennas to the mast. A piece of phenolic is used to insulate the booms from each other and from the mast.

arrays of more than 20% bandwidth are to be stacked, however, they should be tilted toward each other, as shown in Fig. 5. This keeps the "active" zones of the stacked antennas at a constant wavelength separation, regardless of the frequency, thus insuring a constant pattern shape. The amount of tilt should be that necessary to bring the (imaginary) apexes together. Up to perhaps six or eight antennas can be stacked by this method, and gains as high as 20 dB are thought possible. The angle between stacked sections should be something between two and four times α, which gives approximately ½-wave to a full-wave spacing. It will be necessary to use smaller (2α) angles for larger numbers of elements and larger α angles. When four antennas are to be stacked in a 2 x 2 array, they take on the appearance of a pyramid. Such arrays have been built for UHF TV reception, and, on a larger scale, for satellite tracking.

Be sure, when stacking either L-P's or yagis, that they all have the same side upward. Otherwise, when two are stacked, the phasing is 180 degrees out and a null instead of a peak will occur in the desired direction. With three or more antennas stacked, all sorts of peculiar but undesirable patterns will result if one or two are inadvertently turned over.

L-P's can be made to cover two different frequency ranges if you want to shorten the boom and eliminate a band in the middle. Just leave off the elements shorter than necessary for the lower band, and put the longest highband element where the next low-band element would have been. It is also possible to change the α angle and τ factor in mid-band, so that higher gain can

be obtained at the higher frequencies. Neither trick seems to mess up the SWR curves or patterns in the desired ranges.

Cross-polarized L-P's may be constructed by using a structure of four booms, as shown. The outputs of the two feed cables, if they are kept the same length, can be combined in a hybrid ring to give right- and left-hand circular polarization. Special wideband hybrids have been developed for use with L-P arrays and the like, which work over frequency ranges on the order of 2:1 and more.

Getting it working

After you have designed your antenna and have built the two halves, the best procedure is to temporarily mount them together in some way so you can put the antenna out in the clear and make an SWR test on it. The tests should be made with several spacing values, to see what spacing appears to give the best average SWR. If you are building an array, this only need be done with one section; the results are very repeatable. If you don't have SWR equipment, a good guess at the spacing will most likely give SWR values not more than 50% higher than the best obtainable. This is another advantage of the L-P over the yagi. For amateur TV transmitting work, an SWR of 1.3:1 or less, is desirable to keep from transmitting "ghosts". It is possible to obtain this SWR over 20 MHz, or more, at 432 MHz by adjustment of the boom spacing (see Fig. 7).

If the antenna is to be side-mounted on the mast, the SWR curve should be checked unmounted, to set the spacing, and then mounted and rechecked. The mast should be as slim as possible in the case of 420 MHz antennas. The preferable way to mount small L-P's is from the rear. Dielectric masts, rather than metal, might be used more successfully for the side mounting. The final test of the effect of side mounting the antenna, is to confirm that the main pattern lobe is on the axis of the boom. If it is desired to rear mount an L-P, the booms can be extended back about 14 wave (at the lower cutoff frequency) past the rear element and shorted together on a mounting plate. Side mounting is as much a problem at 420 with vagis as with L-P's, and rear mounting can sometimes help solve pattern problems.

Building the "Log'Scan 420"

If the specifications for this array created interest in building one, the required aluminum from a local jobber will cost about

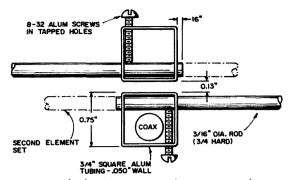


Fig. 6. Method of mounting the antenna elements to the booms used in the "Log Scan 420" log periodic. Clearance for the coax feedline is provided by installing the screws next to the wall of the boom.

\$10.00. The boom material is % inch square stock with .050 wall—preferably % hardened. The elements are ¾6 inch rod, % hardened. The elements are made long enough to pass through the boom and protrude about ¼6 inch on the opposite side. Each of the four identical sections requires two 41% inch long boom pieces and about 13 feet of rod (multiply by four to build the array). The lengths and locations of the elements are given in Fig. 8. Note that the elements are not centered on the booms, but are moved toward the other boom as far as possible.

Elements are held in place by aluminum 8-32 machine screws which are threaded through the boom as shown in Fig. 6. They should be as close to the wall as possible, to leave room for the RG-8/U feed cable. These screws can put quite a bit of pressure on the elements to insure good contact with the boom; this is important. Since I was worried about corrosion, I rechecked the complete SWR plot after the array had been up some months in the humid, corrosive atmosphere near Cape Kennedy, and found no change.

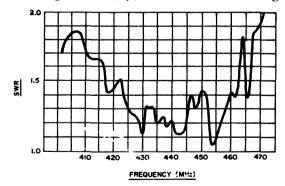


Fig. 7. SWR plot of the four stacked "Log Scan 420" log-periodic antennas. This antenna was designed for use between 410 and 450 MHz; between these points the SWR is less than 1.7:1. In the 420 MHz amateur band, the SWR is less than 1.5:1.

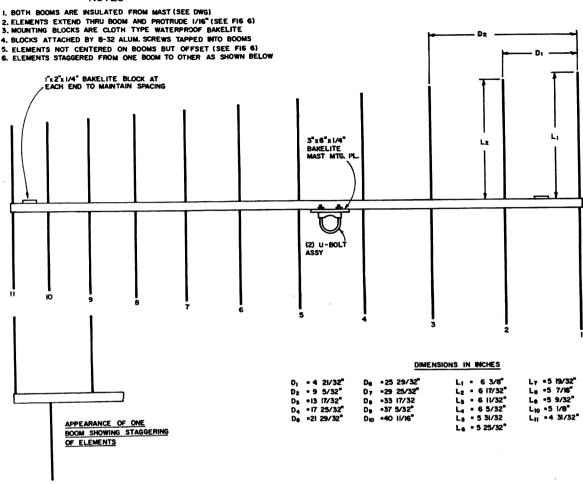


Fig. 8. Top view of a log-periodic antenna exhibiting about 12 dB gain. When four of these antennas are stacked, approximately 17 dB gain is possible. The SWR from 420 to 450 MHz, when fed with 50-ohm coaxial cable, is less than 1.4:1. LI should be 6¾" long, not 6¾" as shown.

The ideal antenna would be all welded, and while this might add \$30-\$60 to the cost of the array, it would virtually last forever.

mast mounting assembly needed), shown in the photograph, is made from a piece of waterproof bakelite, ¼ x 3 x 6 inches, and two TV-type U bolts and clamps. Near each end of the boom pair, an additional piece of bakelite, ¼ x ¾ x 2 inches, is used (on the side opposite the mast mounting) to hold the booms in alignment at the proper spacing of 0.150 inches. Both mast mounting plates and end supports are held on by aluminum machine screws tapped into the boom. Tho lower boom carries the feed cable, and these screws should be offset toward the upper boom to leave as much room as possible. The cable should be run through the boom before the elements, set screws, and supports are installed.

The cable attaches to the front of the antenna with lugs, keeping the lead lengths as short as possible. All exposed parts of

the cable outside of the jacket, and all of the area around the lugs and attachment screws should be covered with RTV silicon rub-

ber to insure that moisture cannot cause

trouble. Tape or other protection should be

used on the cable where it leaves the rear

boom, to prevent fraying of the cable jacket. The sections are stacked 21 inches apart, and each cable should extend about 42 inches from the rear of the boom. Match cable lengths and types.

Type N connectors, UG-21/U, should be used on all cables. The cable matching section, which was explained earlier, is shown in Fig. 4. Each ¼-wave transformer is 4 inches overall length, leaving about 1 inch of jacket showing between the UG-21/U connectors. Triple-female tee connectors, type UG-28A/U are used for the three tees. The length of conductor inside each tee constitutes part of each ¼ wave transformer, and has been taken into account in the length calculation (which has been verified by

measurement). The 4-inch sections must be made from solid dielectric RG-8/U; foam dielectric would require a shorter length. Recommended antenna feed line for lengths under 60 feet is foam RG-8/U, which has a loss of about 3.9 dB per 100 feet; over 60 feet, RG-17/U or ½-inch foam Heliax, both with a loss of 2.3 dB per 100 feet; and over 100 feet, ¾ inch Heliax, with a loss of 0.8 dB per 100 feet.

Each section of the array has a 50-ohm impedance, and can be tested for SWR if you wish to verify that all sections are electrically identical. Needless to say, a single section can be used as an antenna with 12 dB gain. The individual SWR curves are fairly similar to the overall array plot in Fig. 7. If you wish to obtain the lowest SWR at any one part of the 420 band, it will be necessary to scale the antenna element lengths and location distances slightly, in one direction or the other. I would also recommend one additional set of elements at the low end and two additional sets at the high end, if the antenna must have equally good front-to-back ratio and patterns over the entire band.

The τ factor for the array is 0.97 and the α angle is 2.5 degrees. The design horizontal

beamwidth is about 40 degrees, and the vertical beamwidth, about 20 degrees. The low frequency cutoff was designed as 410 MHz; the high cutoff, as 450 MHz.

Actual performance of the "Log-Scan" has indicated it works well. The beam is lined up with the boom axis as it should be, and the horizontal beamwidth is close to 40 degrees. The vertical beamwidth has not yet been measured, but the gain appears to be about right when compared to several yagi antennas. The high and low frequency cutoffs shown in Fig. 7 are within a few percent of the design cutoffs.

I started building L-P's with the design and construction of a 110-300 MHz single planar log-periodic. Patterns and gain were both good. It has an α of 15 degrees and apparent gain of about 8.5 dB. The second log-periodic I built was a 50-300 MHz planar with two different τ factors, the change to a larger factor being made at 100 MHz. It does a good job on three amateur bands, all of the VHF TV, FM, the 225 MHz telemetry band, and quite a bit more. I am already convinced—try one yourself and be convinced, too.

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Applications for the Dual-Gate FET

Using the 3N126 as a mixer or balanced modulator.

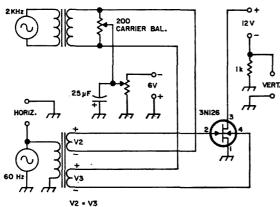


Fig. 1. A 3N126 balanced modulator which was breadboarded to measure performance. In this circuit, a 2 kHz audio signal was used as the "carrier", a 60 Hz signal as the "audio".

The Motorola 3N126 dual-gate FET looks like it might have some interesting possibilities. A bit of bench work showed what it would not do, and some of what it will do. But then again, maybe not any better than anything else.

The 3N126 is not a product device, at least not in the same sense that the 6L7 and 6BE6 are. It is an FET with two gates—essentially the solid-state equivalent of the old Wunderlich tube which was never very popular. When bias is put on gate 2, the drain-to-source current is reduced, but the transconductance between gate 1 and the drain does not change much until the current is completely cut off.

If a signal is applied to both gates, the device provides just a bit less than twice the transconductance than when using gate 1 alone, and it more closely follows a square-law curve. A 3N126 with zero-bias drain current of 4.5 mA and cutoff of about three volts performed best with both gates biased about one volt negative.

The dual-gate FET can be used as a mixer, with the signal on one high-impedance input and the oscillator on the other. The oscillator swing should be about 6 volts peak-to-peak on gate 2. Under this condition, the gate could be self-biased with a 500k

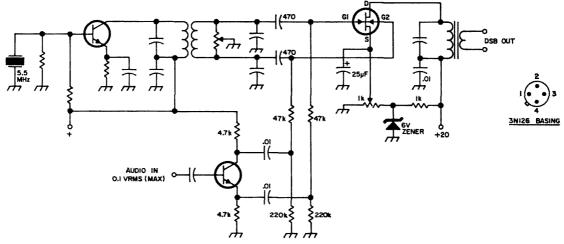


Fig. 2. Proposed 5.5 MHz SSB balanced modulator based on the results with the audio model.

grid leak (gate leak?). As a self-oscillating mixer it should be convenient to use and works well to at least 100 MHz.

Another application for the dual-gate FET is in a balanced modulator circuit. To see how the 3N126 would perform as a balanced modulator, I breadboarded the circuit shown in Fig. 1, using a 60 Hz "audio" signal and a 2 kHz "carrier". Best operation was obtained with a quiescent current of 0.5 mA, peak current of 0.9 mA, 2.4 volts negative bias, 6 volts peak-to-peak "audio" on gate 2 and 4 volts peak-to-peak "carrier" on gate 1.

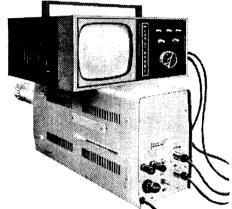
With these operating conditions the peak

output current is 0.4 mA into a ten- or fifteen-thousand ohm load (assuming a 20 V supply), or a maximum level around -10 dBm. The balance stayed good over a wide range of temperatures. Note that the carrier voltages must be unequal for best balance; in the circuit of Fig. 1 the audio was applied as equal voltages and there was some audio on the output.

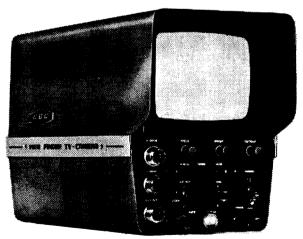
Based on the "model" balanced modulator of Fig. 1, the proposed 5.5 MHz SSB balanced modulator in Fig. 2 using a 3N126 should work quite well.

. . . WIOOP

Rube Goidberg would have liked this piggy-back arrangement...



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Getting to Know Your Receiver

Modern receivers are wonderful! They are full of dials, knobs, switches, and all kinds of goodies. Typically, the amateur goes to the local ham haberdashery, pays his \$400 or so, and takes the receiver home with great pride. He then proceeds to plug it in, set the rf gain wide open, the bandpass on 2.5 or so, switch on the AVC and the product detector, and from that day forward the only adjustments are made in the audio gain and the tuning dial.

If this was what the designer/manufacturer had in mind he would have pre-set all these controls and saved a lot of headaches in the manufacture of the receiver. Each of these controls has a purpose. Learning to use them effectively can make your hours on the air a pleasure. Ignoring them can lead to all kinds of discomfort. Let's take a case in point.

Let's say you call a CO and are answered by a station who has a strong signal. Skip conditions are good, the band is open, and after the usual amenities he tells you he has a new rig on the air and would like you to give him a critical report on his strength, the width of his signal, and suppression of the unwanted sideband. Here is your golden opportunity. You are sitting with the ultimate in receivers and feel confident that you can really show off. You check his S-meter reading . . . great, he is 30 dB over 9. You tune to the sides and discover he is about 10 kHz wide . . . hmm, that's pretty broad. You switch to the other sideband and find his suppression leaves much to be desired. So, since he asked you for a critical report, you are completely honest with him and tell him all these good things about how his signal really isn't too great.

Granted, it is possible that he really does have a bad signal. But, you might very well have ruined his day by giving a faulty report when your receiver was to blame. Let's rephrase that . . . you may have been at fault by poor operation of a fine receiver.

Let's recap the report. We won't argue

with the S-meter reading, although this is strictly relative. Three receivers, even the same make and model, can easily give three different S-meter readings. Your meter said he was 30 dB over S-9. Any way you look at it, this is a strong signal. This kind of signal, especially on 20 meters when conditions are good, can overload the front end of any sensitive receiver. Now, we have to question the 10 kHz report of bandwidth. Was he really 10 kHz wide, or was your rf gain open to such a degree that your receiver couldn't accept this strong signal and reflected a broadness which really didn't exist? Is it possible that by backing down on the rf gain (not enough to disable the Smeter) you would have reached a comfortable listening level, still have come out with the 30 over 9 report, and found he was well within the limits of broadness? It's not only possible, it's even highly probable. But think about the poor guy on the other end. Here you sit with a Pfluggenhoffer 600 receiver. which is considered to be the best on the market, and you give him a bad report. He may accept the fact that he is broad and turn his audio gain down to a degree where he may never make another contact.

Now, how about that report of unwanted sideband suppression? Your AVC was on, wasn't it? One of the functions of the AVC is to make the most of a weak signal. Unless his unwanted sideband is remarkably suppressed, your AVC is going to pick it up and boost it as much as possible to make it readable. Bet you hadn't thought about that. Your AVC doesn't know that this is an unwanted signal. Before trying to give a report on sideband suppression, it is necessary to disable the AVC of your receiver or you are going to give out a false report. The poor ham on the other end is liable to spend days trying to suppress the unwanted sideband, when in reality he was doing fine all along.

Another case in point. There is another ham who lives just two blocks southwest

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from you and when he is on, you might as well watch TV for all the pleasure you will get from ham radio. Usually this situation leads to animosity (to say the least) and the definite increase in the number of anglosaxon obscenities which sneak into your vocabulary. I will admit that if he has a schedule on 14.280 with someone who is in the North-East, and you have a schedule on 14.285 with a station in the South-West, you have a problem. Your beams are going to be aimed directly at each other, and there isn't anything you can do except take turns calling and listening until you establish contact and then get as far from each other on the band as you can. However, if you are engaged in just hamming and it makes no difference to whom you talk, you can no doubt get along fine. I've known hams in the same block who managed to work well by efficient use of their receivers. I did it for several vears.

This requires tact, diplomacy, and knowing how to use your receiver. You will both have to put your heads together and cooperate, but it can be done. Let's assume he was

on the air first and is on 14,280. At best you are going to have to get 25 kHz away from him. So, you move up or down as you choose. Listen to see who he is working. If he is in OSO with a station located to the North-East, turn your beam (I do hope you have one) so that it's null point will cut him out as much as possible. Now, cut your rf gain until he drops out of the picture and rather than calling CQ (where you might be answered by a weak station) look for someone to talk with who has a signal which is strong enough to get through to you; and begin a QSO. Chances are you will block your neighbor's receiver until he realizes what is going on, but then he can take the same measures and continue his OSO in reasonable comfort.

Far too many of the complaints we hear about QRM and splatter are really the fault of the ham's own inability to know his receiver and it's capabilities. Learn what all those knobs and switches do, and if you still leave your receiver wide open for the "Sunday Punch", you have no one to blame but yourself. . . . WØHIL

The Silent Shepherd

"For heaven's sake, you're not going out there now, are you?! Why, it's the middle of the night!" Martha's sharp voice knifed through the dark bedroom. Al pulled on his bathrobe and reached for his slippers. He braced himself for the onslaught he knew was coming.

"Don't you get enough on weekends?? Do you have to listen to that gibberish all night, too?"

Al paused in the doorway. He spoke soothingly, as though to a petulant child. "I know it's late, but I'm restless. I'll listen around the bands a while . . . it'll relax me and it won't bother you . . . I'll keep the door closed. Go to sleep now, honey. I'll be back soon".

Martha jerked the bed covers up around her ears and turned her head to the wall.

Pensive, Al headed for the garage where his equipment waited like a buried treasure . . . a source of comfort and satisfaction . . . even a refuge sometimes. He longed for Martha's acceptance of his hobby; not necessarily her partaking of it, but at least a tacit approval. "Although, maybe I do spend a lot of time out here", he admitted ruefully. A deep sigh escaped him. "Well, I'll make it a short session tonight; no use aggravating her any more than necessary."

He threw the master switch by the door, and felt a surge of pride as the powerful gear sprang to life. He loved these squat boxes, warm and alive with promise. He thrilled anew when he heard them purr with contentment as power coursed through their wire veins. He followed anxiously their every heartbeat, revealed by the swinging needles in their opaque windows; and he basked under the bright gaze of the tiny green and red eyes on their flat faces. Stationed on the roof, the multi-fingered antenna clawed at the sky, gathering in radio waves like a giant hand sweeping crumbs from a table.

He settled himself at the glass-topped desk, slipped the headphones down over his ears and spun the vernier dial on the receiver. Signals were thinly scattered between static crashes.

"Damn", he thought. "Just when I feel like ragchewing, either the skip is wrong, the band is out, or nobody is up". He spun the knob the other way, and heard the flash of a faint voice; oriental music wavering through from the Pacific area; and the regular pulsing of the electric blanket in the house. "Have to make a filter to eliminate that", he reminded himself.

Suddenly he stiffened. What was it he had sliced across? MAYDAY! Good Lord, was it? MAYDAY?

Swiftly, every nerve alerted, he backtracked. He pulled the needle cautiously along the dial, delicately probing for his quarry. Had he imagined it? Could he find it again? "Keep calling", he urged silently. "Don't give up! I'll find you, only don't stop calling!"

There it was again! Mayday! Delicately he rocked the knob across the spot until it was dead-centered. Then he zeroed his VFO on

it, and crossed his fingers for luck. The voice vanished. The static had engulfed it like a turbulent wave sweeping over a bit of seaweed.

He threw on the transmitter switch, grabbed up the mike and began calling.

"Q R Zed the station calling Mayday. Q R Zed? This W6JFD, Vallejo. Over".

As he waited, he licked his lips and tasted salt. Then it came, haltingly.

"W6JFD K6VLE Mobile How copy?"

"Not solid, but think I can pull you through. What's your problem? Break".

"Hurt been trying hours raise somebody" Labored breathing punctuated the rambling answer. ". . . my car and when when woke up down here . . . canyon legs pinned under boulder . . . and door frame . . . can't pull free . . . real mess . . . help me?

Al detected growing panic in the voice. "What's your exact location? Break". "Don't know . . . never here before . . ."

Despair spanned the gap and crept into Al, too. He must learn more, and fast. The man thought he was four or five miles from the junction. Which junction? Laguna Road and Highway 80. Near what city? East of San Diego. As he faltered, Al patiently prodded him on.

His headlights were smashed, he said. Flashlight? Yes, but couldn't reach it. No, the horn hadn't worked for months. Landmarks? He seemed to remember crossing a bridge just before

Finally the delays between his words lengthened ominously, and he moaned,

"Can't think more . . . pain's bad . . ."

Al forced himself to speak casually, "Hold on. I'll cut out here, and send some blind calls. See if I can raise somebody closer to you. Six hundred miles is a long haul; maybe we can trim the odds. Stand by".

With deftness and speed, Al set to work, calling and listening. Calling and listening. Finally he conceded defeat.

"Sorry, buddy. No luck there. How're you feeling now? Over".

There was no reply. The distant transmitter, however, appeared to be operative. Its electronic stream buoyed the needle on Al's meter, marking the place on that turbulent sea of sound where the voice had

Now the odds had shifted. Rescue could

be seriously delayed. The ugly threat of gangrene insinuated itself into his mind. He recalled isolated battlefields and fallen men; bloodless limbs and lurking rot. Apprehension spurred his thinking as he conceived intricate solutions that dissolved under the pressure of practicality.

He fumbled absently for a cigarette. Then he knew. Rapidly he dialed Highway Patrol headquarters and outlined his plan to the

police dispatcher.

Now he could do nothing more, but was reluctant to leave his post. Maybe he would come to know if the man was found. With sightless eyes probing a dark canyon, maybe he could somehow know.

He remained at the dimly lit operating desk, head lowered, slowly doodling along the margins of the logbook. Outside in the sleeping streets, a dog howled its loneliness.

He did not know how long he had sat there, when the receiver abruptly sprang to life. His head snapped up as a voice cried, "Here he is! Over here! Let's have those lights over this way more!"

Loud shouts and crashes displaced the

stillness he had been monitoring.

"Easy there easy lift him up easy".

Al was jubilant. He sat transfixed as he visualized the scene performed by actors unaware of their audience. Finally the din abated, then faded completely as evidently the men bore their burden up the canyon

Al pushed back his chair, and, with hands clasped behind his head, arched backwards in a tingling stretch. Yawning widely, he rose and leaned forward to switch off the receiver. He paused midway. Two stragglers, apparently, spoke.

"You can chalk this one up to you public utility boys! Those portable field strength

meters sure came in handy".

"Yeah, Lucky this guy's transmitter gave us a steady note to home in on; what's rough is trying to trace some erratic appliance that's tearing up all the TV sets in the neighborhood!"

"What I can't figure is who sucked you guys in on this deal in the first place?"

"Well, all I know's the Patrol rousted me outa bed and says get all my gear together . . . and something about some amateur radio operator around San Francisco hearing this guy's call for help, and

"Jeez, you mean some guy six hundred

miles away?"

The disbelief in the question made Al laugh aloud, while the voices slowly dimmed and finally merged into the ether from whence they had sprung.

This was one time, he reflected, where a mobile rig really paid off wonder what kind it was it put out a pretty good signal. Maybe someday he would have one—Martha might even get a kick out of it, especially on long trips.

His reverie was shattered by the metallic jangle of the telephone.

An amiable police reporter requested more details of the incident. How long had Al had this hobby? Did he know the other man involved tonight? Would he mind if the local papers ran the story? Al hesitated. He hadn't anticipated publicity. In the end, he capitulated, with one reservation: "Remember, now, none of this 'big hero' stuff!"

Clearing the desk top, he looked forward to getting back to Martha so she could share his elation.

She woke on his arrival, and struggled up onto one elbow.

"It's about time you got to bed! Staying up 'til all hours with that silly radio stuff. Honestly, sometimes I swear I just don't understand you!"

He knew a sudden tiredness. Mutely the golden moment fled.

He lowered his head to the pillow and closed his eyes. Tonight his life had been briefly entwined with that of a stranger, and the union had borne sweet fruit. This would always be his secret glory. Pleasure warmed him.

Gently, he said, "Go back to sleep, Martha".

. . W6OQY

Your Station Log — A Legal Document

A radio newcomer asked the other day, "What evidence do I have that I'm bonafide when my license is at the FCC for modification or renewal? I understand a photostat is not acceptable evidence for operating another station in the absence of the original license." The answer lies in that most important record, your station log.

Whenever your license leaves your possession for any reason, a written statement concerning its whereabouts should be placed in your log. This notation should include the date and where it was sent as well as its current expiration date. Should the Radio Inspector visit your station, this is valid evidence to him (since your log states it is accurate to your best ability unless proven otherwise) that you hold a valid license. This log item offers you additional protection as well. If your license was sent to the FCC prior to its expiration date, you can continue amateur operation after its expiration pending the return of the new document from the FCC. These few words in your log offer you a world of protection.

Similar to a ship's log, also a federal requirement, your station log is a chronological record of the station activity. At a government hearing or court action, a subpoena can be issued for its appearance as evidence (people's exhibit) in the case on the part of

the prosecution. Unless proven in error, your log is accepted as legal evidence that you were on the air at the time stated and in contact with a particular station for a specific period of time on a certain frequency band and mode. This is not testimony; it's written in black and white on paper and very convincing to any jury.

Don't overlook the fact that your log can contain other personal information concerning your station for future reference. Such information can take many forms:

- 1. When you put up that new beam; its SWR, etc.
- When and what tubes (or transistors, or other components) you placed in the rig.
- A record of QSL's received-sent, WAS or DXCC.
- 4. Notes regarding skeds, nets, originated message numbers, etc.
- 5. If mobile, where you were; rig maintenance and last tune-up.
- 6. Many more.

Yes, your station log is a most important legal document and deserves your careful consideration at all times. Keep it right up to the minute to the best of your ability.

. . . George W. Tracy, W2EFU printed by courtesy of SARA NEWS. The Schenes-

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Torticollis and all that Jazz

Being a YL can be frustrating, and at times, a pain in the neck.

If you look for "torticollis" in a dictionary, you will see that it is defined as, "An affliction causing twisting of the neck and an unnatural position of the head". Translate that verbiose passage into everyday English, and you'll find that it means, "a pain in the neck".

I've been a ham for over a year, now. I graduated from Novice to General; I went from a simple novice rig to an advanced (?) general one, and I have perforated the wall of my ham shack with tiny thumbtack-sized holes—guess what they're for. But in all my time as a ham, I don't think that I have given many torticollis, and I haven't suffered from that affliction to any great extent (other than the pains caused by fruitlessly calling CQ for hours at length). In fact, every moment of my ham career has been a sheer delight.

That statement isn't quite truthful, though. While I've undergone no great trials and tribulations during this time (other than the loss of nails on the way to the FCC office), I've had a few experiences that no OM has ever had.

When I first got my ticket in August of 1965, we were living in an apartment. I did not have a transmitter, and the owners of the building were very unfriendly to my cause. As I sat by my faithful SX110, staring at that piece of paper that declared to one and all that I was WN6QOT, I vowed that I would get on the air just the same.

I did-two months later.

After we moved into a house, plans were

made concerning my on-the-air debut. A friendly local ham, from whom I purchased my rig, and who helped me immeasurably in the months to come, aided me in erecting a skyhook. It was an inverted vee for forty meters, on a ten-foot pole on our roof. That antenna is still up there, but now it shares the pole with two other inverted vees—one for 20 and one for 15 meters.

To get back to the narrative . . . finally, all was in place. I listened around, called a few CQ's, but did not get any replies. Then I heard a station calling CQ on my crystal frequency. I threw the knife switch to transmit, called him, and he came back. His call was WN6PVF, his name was Don, and it was the most exciting QSO I ever made.

The next day, I arose bright and early to try to work a few stations. I tried a call. No reply. Another call. Ditto. Five hours and fifty tries later, I happened to look very closely at the knife switch, and found that a lead had been loose.

Technical boo-boos, though, are common. Almost everybody has them. But the things which cause the most torticollis are of a different nature. Are they different!

As a novice, working only CW, I was called "OM" at every turn. A typical opener on the part of the other party would be "GE OM." Some of the more persistent chaps punctuated almost every statement with an "OM". "UR RST 579 OM" "QTH PODUNK OM BT NAME CHUCK OM SO HW CPY OM?" etc. Majority rules, but when you're

in the minority, this thing gets pretty wearing.

For the first few times, I just gritted my teeth, waiting to say, "NAME HR IS CHERYL CHERYL ES IM A YL YL." I wondered if any of those who insisted upon the use of OM and found out that the "OM" with whom they were conversing was a YL ever felt the least bit chagrined.

Speaking of YLs and OMs, I was in QSO with a WN6 whose name was Pat. Having a particularly acute case of foot-in-mouth disease that day, I remarked brightly, "It's so nice to meet another YL on the air." I chattered gaily on about how there were so few of us, and I inquired of my erstwhile friend when she had received her ticket and how she had become interested in hamming. I turned it back, received hasty 73s and an SK. After this, I looked that WN6 up in the Callbook. Woe unto me when I discovered that his name was Patrick!

All this time, I had been studying feverishly for my general. My parents and friends wondered where I disappeared to every night, carrying those thick books. Closeting myself in the shack with the Radio Amateur's Handbook, I pondered the difference between a Class AB1 and a Class AB2 amplifier. W1AW was my best friend during this period, as it whispered sweet dahdahdidah dididit dahs in my ear.

At last, the test-taking time came. I was fairly sure that I would pass the code, but I wasn't certain at all about the theory. I walked into the office, filled out the forms, paid the four dollars. Then the announcement came that the code test was to start. Pencil in hand, I waited. Say, this wasn't too bad! Then I found out that I had passed. Next came the sending—passed again! Now the biggest hurdle was approaching—the theory. Old trepidation in person, that was me! I managed to pass, though, and I practically danced all the way home!

Now the long wait for the ticket to arrive. Time for rig-looking, along with some ham friends. With their aid, I managed to buy a used HT37 in mint condition, and the wait went on.

The ticket finally came on January 29, 1966. Now I could see what phone operation was like! At least, no one would think that I was an OM using that mode.

That's what I thought.

I happen to have an alto voice, which means that, on sideband, some do not know

to which sex I belong. This presented problems, to say the least. For instance, there was that QSO with a W6. "Good evening, old man. (I felt safe in saying that, since I could tell by his voice.) You're Q5, S8 here in Panorama City, about eighteen miles north of LA. Name here is Cheryl, C-H-E-R-Y-L. So how copy?" I felt sure that my name and voice indicated that I was a YL.

Back he came. "Good evening, Cheryl. You're Q5, S7 here in such and such. Name here is (I can't remember it now, but for the sake of argument, let's say it is) Fred." A pause. "So back to you, and, uh, by the way, are you a boy or a girl?"

Well, I informed him of my gender. When he came back, he said, "I wasn't sure because there are quite a few boys whose voices are changing, and I couldn't quite tell what you were."

That's true, but . . . A boy named Cheryl?

What next? Well, as time went on, this episode was repeated quite a few times on phone, and as for CW... you are male until proven female. I was, and am, therefore, in the habit of saying, "Name is Cheryl, Cheryl, and I am a YL YL." Even so, a few fellows ask me to repeat my name. I guess they can't believe their ears.

I was advancing in my ham career. Now on 40, 15, and 20, and with a Drake 2B (I had traded in my trusty SX110 and a fifty dollar gift certificate won at a local hamfest), I was busy ragchewing, trying to DX, and dipping into construction.

About DX . . . considering the antennas, I have not done too badly. 17 countries and 44 states worked—not a record, but I've had a lot of fun doing it.

Remind me to think of that while in the process of trying to make myself heard in a pileup of kilowatts on 20 SSB!

Seriously, though, my first love in hamming is ragchewing, and it's all the more interesting when it is with someone out of the immediate area, though I enjoy yakking with the locals, too. I despise rubberstamp QSOs, but, contrary to the theories of a few hams whose articles I've read, most hams are not tongue-tied idiots with nothing to say beyound, "RST . . . QTH . . . NAME . . . RIG . . . WX . . . 73 ES CUL . . . SK". Most hams—most people, for that matter—are interesting to talk to, and have a lot to say.

To get back to the subject of QSOs, I have been a great disappointment to many. I'm

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speaking of those fellows, stationed on some lonely island, who haven't seen a girl or even heard a feminine voice for months. Take, for example, a certain KL7 who worked me once. We were talking and he mentioned the fact that he was on a solitary island. He then asked how old I was. "How old do you think I am?" I shot back. "About sixteen or seventeen," was his reply. This was flattering, and maybe I should have let him think that, but I decided to tell him the truth. Imagine the look on the poor fellow's face when he found out that the YL he was talking to was only thirteen years old!

That reminds me of another incident which took place shortly after I first got my general. I contacted a WA7 who was maritime mobile at the time. He mentioned that he was about six hundred miles off the coast of California, and that he would be docking in a few days at Los Angeles. He said that he might pop down and visit me. I thought he was joking, but I hadn't told him my age, either.

About four days later, there came a knock at our front door. My father got up to answer it. I was standing in the hallway, so I clearly heard the conversation that ensued. "Yes?" said my father.

"I'm Don, WA7XXX, maritime mobile. Is Cheryl here?"

"Just a minute." Daddy walked down the hall. Finally, drawing near, he said, "There's a boy here who says . . . "

"I know; I heard."

In the meantime, my mother had invited him in. Here he was now, walking toward the shack. "Cheryl?" he inquired questioningly. I nodded, and he walked into the ham shack in silence.

I didn't have to imagine the look of shocked surprise on that young man's face—I saw it!

Hamming hasn't held too many other little incidents recently. Going to the local radio clubs, checking the rigs over, replacing a few tubes and fuses, working my first European, a UA—quite a feat for me! Learning more about electronics, trying to build a few things, and just enjoying the hobby in general.

Learning about the technical aspect of hamming has interest for me too. I think I'll try some RTTY, and who knows, maybe even ATV.

Maybe then they'll know what I am!

An All-Band Rotatable Dipole

Want an antenna with 8 to 10 dB gain, small dimensions, all band operation, low angle radiation, low SWR, and a low price? No such animal.

But, if you'll settle for one with little or no gain, (but a good front-to-side ratio), comparatively small dimensions, a fair radiation angle for DX work, a good SWR, (below 2:1), and a very low price, this is it.

I feel that no real explanation is necessary. It is simply a dipole for 40-10 meter work; on 80 it can be loaded with a little experimentation. Get this antenna up 50' off the ground on a rotator, and you've got it made.

The coils, L₁ and L₂, are B&W #3022 miniductors, which you should be able to grab for \$1.25 or so apiece; insulators are Johnson type 65, selling for about 30-35 cents apiece. The two 16' elements are ½" diameter electrical thin-wall tubing, either aluminum or steel conduit. The wooden support is a 2 x 2, about 6 feet long (paint it); the mast is a TV mast, preferably leading to a rotor at the bottom.

Mount all of this as shown in Fig. 1 and that's it. The antenna should be fed with 52 or 75 ohm coax and the coils tapped for the lowest SWR on the preferred band. If you tap them for 40 (usually about 10 turns

onto the coil from the element) the antenna works fine on 40 and 15, and sometimes even 80. Tap for 20 (low end of the band, about 1 turn of coil; high part of band, bypass the coil completely) and it works well from 20 through 10. For 10 meter operation, the lowest SWR will occur when there is no inductance at the antenna (bypass the coil).

You can check the SWR while the antenna is still on the ground if you like, as very little, including transmission line length, will effect it to any great extent after it is raised. The SWR on all bands will be better than 2:1 at resonance, and SWR's of 1.1:1 at resonance are not unusual. The SWR will not go above 2.5:1 anywhere in any band if the antenna is built and installed correctly. An antenna tuner will provide nearly instant bandswitching without touching any taps and a pi-net in the transmitter will also help.

Incidentally, this antenna works quite well on 80 and 75 if you experiment with the tapping on the inductor, which for these bands, will be near the bottom of the coil (from the element) for maximum inductance.

The whole system costs less than \$10.00, not including a rotator, but it really performs.

. . . WB2WIK

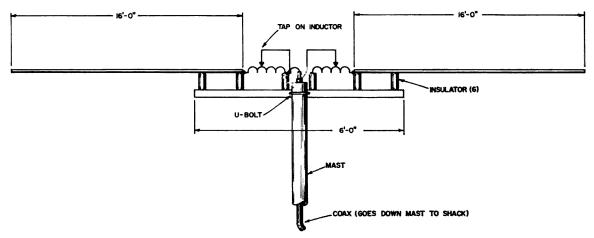


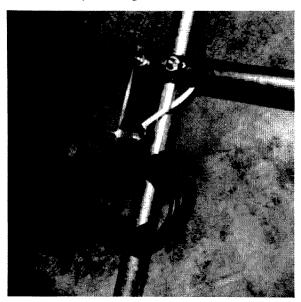
Fig. 1. Construction of the all band rotatable dipole for 80 through 10 meters. When properly adjusted this antenna provides excellent results without a large cash outlay.

A Cheap and Easy Gamma Match Capacitor

Here is a system which can handle a kilowatt and eliminates the mechanical problems in building a gamma match.

The yagi antenna fed with a coaxial feedline is the most widely used antenna on the HF and VHF bands. It is mechanically simple and quite strong. But the driven element of a yagi has a very low input impedance (on the order of 15 ohms) and presents a problem when matching the driven element to a coaxial feed-line. Many antennas use the familiar gamma match to raise the input impedance to a value compatible with the coaxial feedline.

Most gamma matches use an air variable capacitor to tune out the reactance introduced by the gamma rod. This intro-



The cheap and easy gamma capacitor mounted on a yagi antenna. Plexiglass sheet is used to support the end of the gamma rod.

duces both mounting and weatherproofing complications. Often the gamma matching system is more difficult to construct than the rest of the yagi. Fixed capacitors, such as mica transmitting capacitors, have been tried as a means to eliminate the need for a weatherproof enclosure, but the added inconvenience of tuning the antenna with an air variable capacitor, then substituting a fixed capacitor of the approximate value, has proven to be more trouble than it is worth.

While searching for a simpler method, coax cable itself was tried as a substitute. It has a capacitance of from 20 pF to 30 pF per foot depending on the type used. It can be trimmed to the proper value needed, needs no difficult mounting assembly, is just as weatherproof as the feedline itself, and is considerably cheaper than an air variable.

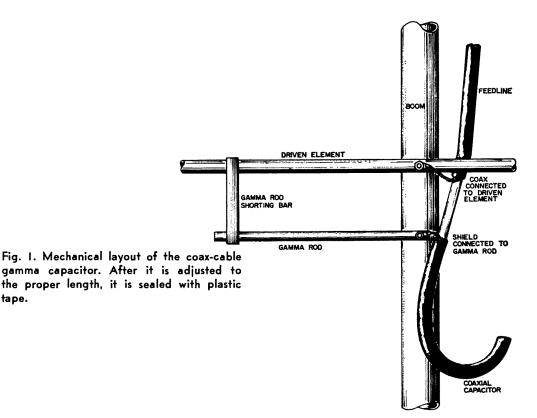
The photograph and Fig. 1 show the mechanical details of the capacitor. The details of the gamma rod are up to the reader. The first step is to determine the approximate capacitance needed for a gamma system on the design frequency of the antenna. The following table shows approximate guide values for a standard three or four element yagi.

20 meters	100 pF
15 meters	75 pF
10 meters	50 pF
6 meters	30 pF

Then determine the capacitance per foot of the coax cable to be used for the feedline.

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RG- 8/U	29.5 pF per foot
RG-11/U	20.5 pF per foot
RG-58/U	28.5 pF per foot
RG-59/U	21.5 pF per foot

From this, the length of coax needed to provide the desired capacitance can be determined. For instance, a ten meter beam would require about twenty inches of RG-8/U for the gamma capacitor. Measure back this distance from the end of the cable and remove three or four inches of the outer vinyl cover. The braided shield should then be cut in the middle of the area from which the cover was removed, making sure not to cut the dielectric between the shield and the inner conductor. The two lengths of shield should be unbraided and twisted to form two leads.

The shield lead from the transmitter end of the coax should be connected to the center of the driven element in the normal manner. The shield lead from the short section used as the gamma capacitor is connected to the end of the gamma matching rod. No connection is made to the center conductor of the coax.

The gamma rod shorting bar is adjusted for lowest SWR at the operating frequency, and then the free end of the coax is trimmed about an inch, and the gamma rod shorting bar is adjusted again. This procedure of alternatively adjusting the shorting bar and trimming the coax is continued until the SWR is reduced to 1:1 at the operating frequency.

After the matching adjustments have been completed, the free end of the coax and the area from which the outer jacket and shield have been removed are sealed with a good grade of plastic tape to keep out moisture. The free end of the coax is then coiled up and taped to the boom of the yagi, presenting a neat and simple appearance.

This system has proven to be easy to construct, rugged, and quite effective.

... KØUTX



Personalized QSLs for Greater Returns

Many and devious are the methods used by many U. S. DXers to coax that elusive QSL from a rare foreign station. Some of the big wheels have such esoteric techniques for obtaining rare cards, that they would just as soon give you the towers off their shacks as divulge their secrets.

What follows is by no means an expose of anyone's private life, but rather some ideas on how to make the rare DX operator notice your QSL from among the multitude so he'll be motivated to send you a card ahead of the competition.

A typical situation is something like this. After calling for six hours or so, you finally work PB41CU in Lower Kumupistan, which is on the Carbuncle River about three inches farther than the map goes. A real rare one. Well, your biggest headache is that Simple Q. Sideband, across town, worked him too. And if you don't get your confirmation before Simple Q. gets his, ole S. will beat you to the draw (more about that later), and his batch of confirmations will capture that first WTW certificate before you even get off the ground. S. Q. keeps bragging at the DX club meetings about how he's always receiving his QSL's from the rare ones "Via air mail within at least two weeks.

How does he really do it? Dear old buddy, you know that S.Q.S. is not about to tell you or anybody else how he does it. He usually says something like, "Shucks. Just sent him my card and some IRCs, that's all. Really very simple!" (That's why they call him Simple.) Well, that ain't all, dear buddy. What you don't know is that Simple Q. Sideband didn't send any ordinary mass-produced QSL. He sent something that reflects his individuality; something that really expresses his appreciation for the DX QSO.

The author has found, from some twentyfive years of DXing experience, that the personal touch is the best way to impress the foreign amateur, and impress him you must, if you want to be recognized. Look at it from the rare DX operator's point of view. To him you're just one more U.S. station. He receives thousands of U.S. cards. One more run-of-the-mill card doesn't turn him on one bit. But if he receives a card that's unique (accompanied by IRCs or return postage, of course) the chances are that he'll be impressed and just might reply sooner than via the usual routes, if at all.

The idea is something like courtship. Once you've snagged that rare one, your dance is just beginning. You've got to make him want to reply to your card. If your QSL has some appealing feature, it shows that you think enough of the foreign operator to send him something special as your thanks for a new country.

Some overzealous types have been known to send the foreign ham a ten-dollar bill, a crying towel, a pound of cheese crackers (broken on arrival), plus heaven knows what—all in an attempt to make a big splash. All this may help, but there's an easier and less expensive way to increase your QSL returns and your prestige at the same time. It's the personalized QSL card. Hand made.

You say you're not an artist? Not important. The method to be described requires little in the way of artistic ability. All you need is some imagination, a little time, and five or six dollars worth of material.

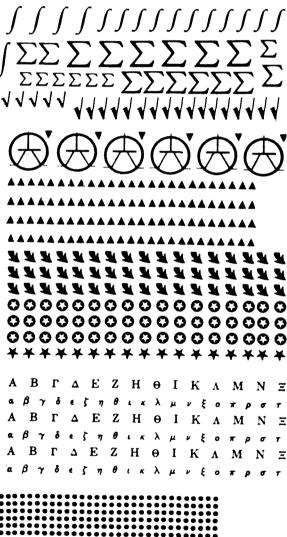
The examples shown are just a couple of the many ideas that have been used. Blank card stock was purchased from a local print shop. (Three hundred blanks cost \$1.85.) The data block (date, time, etc.) was, in this case, typewritten with an IBM Executive typewriter. It is realized that most hams don't have access to such a machine. The next best thing is to have the blanks preprinted with the data block, name, address, etc. This is no more expensive than a regular run of one-color QSL's, and you won't need very many. Or, if you can hand letter the data, so much the better. The hand-applied call letters and decorations are what distinguish the card, and the variety and styles

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are only limited by your imagination.

The call letters and decorations are applied to the blanks using what is known as a graphic aid transfer sheet. These are obtainable at most stores handling commercial art supplies. Many different brands are available. A 9 by 12-inch sheet costs about \$1.50 and, depending upon the designs and characters chosen, contains enough material to make about a dozen QSLs for those special contacts.

Be sure, however, that you obtain transfer sheets. Another type of graphic aid sheet is available that requires the design to be cut out, carefully positioned, and burnished down onto the card. This is laborious and time-consuming, and a faint outline remain-



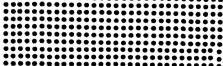


Fig. 1. Transfer sheet used to develop the personalized QSL cards shown in Fig. 2 and 3.

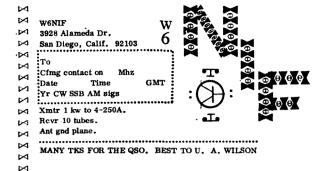


Fig. 2. Personalized QSL card using rows of triangles and the Greek letter theta from two sheets of

mathematical symbols.

ing around the design makes it look "pasted on."

The transfer sheet comes in several colors and contains just about every geometric design, symbol, letter, number, and pattern imaginable. Best of all, it gives your card a professional appearance, and the receiver of the card will wonder how you did it when you tell him it's hand made. Fig. 1 is an example of some of the patterns.

The transfer sheet is transparent, so that characters can be easily applied by eyeball measurement. Once the design is positioned over the card, it is rubbed lightly with a dullish pencil. The design will then transfer onto the card. If you don't particularly like the results, the transferred material can be easily removed by scraping lightly with a razor blade or Exacto knife. Another design will readily transfer onto the corrected spot. When the card is finished, a light spray of fixative (Krylon is good) will make the artwork stick to the card like a bum to a ham sandwich.

In the example of Fig. 2, the call letters and border were made by using rows of triangles and the Greek letter theta from two sheets of mathematical symbols. Fig. 3 is another design using a combination of electronic symbols, Greek letters, parts of Arabic letters, and math symbols. The call letters are made from integral symbols. The cartoon was made by positioning other math symbols on the blank card in various ways. For example, the hair consists of braces; the nose is an upside-down Greek omega; the jaw line is part of a parenthesis. A little experimentation will reveal talents that you never realized you had.

This method of making cards is, admittedly, not a volume process. However, it is one

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Your QSL card will be much appreciated and will be displayed in a conspicuous place for all to behold, with the hope that it will hasten to that everlasting inferno those abominable skeptics who have been known to dispute my word.

BEST WISHES AND GOOD LUCK. A. WILSON "AIT"

dx

dx

Fig. 3. A QSL design using a combination of electronic symbols, Greek letters, parts of Arabic letters and math symbols. The face is also made from transfer symbols: the hair consists of braces, the nose is an upside-down Greek denega, the jaw line part of a parenthesis.

way of expressing your individuality to that rare foreign ham, and it's a pleasant way of killing time while waiting for band conditions to improve. The hard work is already done for you on the transfer sheet. All that remains is to create your own design, no two of which will be exactly identical. You will then have a card that is quite distinctive. If you come up with a design you especially like, an offset print shop will run off as many copies as you want-on your own card stock, if you wish. Each color, however, requires a separate run through the press, and the cost will increase proportionately. However, you will have lost the basic impact you're trying to create: uniqueness will be replaced by just another printed QSL.

It's certainly true that five or six dollars will buy a lot of production-type QSLs. These range from the mundane to the bizarre. Some have three-dimensional letters, fluorescent inks, gold dust, hog bristles—you name it. The author has no axe to grind with the QSL printers. Their products are fine for those who like them. But remember, if you have Print Shop Special Card No. 10 with embossed beer cans in six colors, a thousand other guys do also, and it really doesn't impress the rare DX operator at all.

Much response has been received from foreign amateurs on the author's personalized cards. The QSLs received-to-sent ratio has increased at least 70 percent since they have been used. Most of the comments have expressed approval of what seems to be the exception in ham radio these days: making

it yourself.

. . . W6NIF

Pioneer DX

Working DX in the 1930's was a little different than it is now.

Back in the May issue of 73 (DXpeditions—page 111), our old buddy Wayne (never say die!) expressed a bit of speculation about what DXing was like some 30 or so years ago . . . did it present the problems the DX'ers face today? Somehow that statement electrified the nostalgic nerve in this ol' body; I decided to let him have it. Maybe some of you other 'young oldsters' will also find a bit of entertainment in sharing this little excursion into the 'forgotten' days with Wayne and me.

Let's see now . . . thirty years ago; that takes us back to the late thirties. Not so very ancient as far as the *real* pioneering days of ham radio, but just the same, there's been a lot of changes in the span of the last three decades. Maybe DXpeditions would be a good place to start; in 1937-38 what *was* a DXpedition? No one then had the least idea of equipping a sloop, yacht, sampan or what have you to sail the bounding main in search of way out places where hams were still only something which came with a hog! Now, thirty years later . . . wow! A more controversial subject in the DX

world would be hard to imagine; look at the battle royal going on in efforts to take Don Miller through Hell and high water! Like any other controversy there are the camps of the 'fers' and those of the 'agins'. No Wayne, those kind of run-arounds were unheard of in the good ol' days.

DX was then something which was a thrilling happenstance in most cases. Organized, concerted efforts to work the 'most of the many the farthest away' might have been a dream in the minds of a few hams with a crystal ball but such never left the seance table . . . not right then. You simply put out a 'CQ' slowly and carefully and maybe stretched it out a bit. Then you flipped a switch or two, held your breath and hoped some guy a few thousands miles away and preferably with a zaggy prefix, would take the bait. If you were lucky and did hook up with such, there was no one 'looking down your neck' on the air, nor standing on each others' shoulders to get a whack at your prize the minute you finished. Today? I don't have to tell you; you hear it for yourself. Just sign off with a ZL, VK, IA,



This little Reinartz tuner, built by the author in 1922, served him well into the early 1930's.

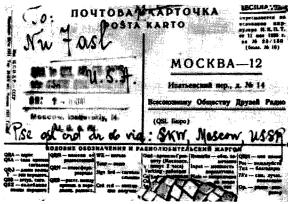


This QSL card from Moscow in 1931 still stands as the author's record DX! 40 watts input on 40 meters brought it. The prefix for U.S. calls for a short time then was "NU", hence, the author's call appears as NU7ASL.

G, DJ . . . any of 'em, and all Hell breaks loose! Transistor pip-squeaks through kilowatts plus (?) get in there with both feet. A good simile is the aggregate rolling around in the drum of one of those mobile readymix concrete trucks! Worse yet, a lot of guys even try to beat the other highwayman of the air lanes' by jumping in to call your man even before you complete your signoff! In 1937-38, when you finished such a contact, you were more likely to call a pal or two and tell them that you just finished working a VK, give him the frequency and suggest he try for him . . . probably no one else there now anyway, and generally there wasn't, and your buddy raised him first call! Utopia? Well, maybe not exactly but it sure was in comparison with what the DX hounds face today!

And what did you do when you'd hooked the guy? Use today's modern procedure, slipping him a quick RST, promise a QSL and beg for his? Maybe a fast 73 and without releasing the mike button or the key knob, jam out a long 'CQ DX' again? Hang on and hog the frequency by all means if you can, seems to be todays popular practice!

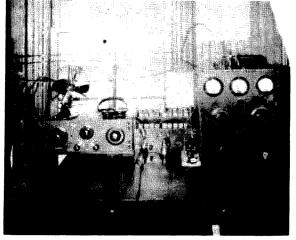
In the thirties, when we'd hook a way-off guy like that, we took keen delight in jawing a bit. What did he do for a living in his country . . was he a youngster . . student maybe, or perhaps a hard working cop in Brisbane? You gave him the low-down on your family status, job, weather and similar purely rag-chew matters. You found out a lot about life in foreign climes, thereby broadening your own knowledge of the world and it's peoples. Today you know that the other guy knows what 73, RST



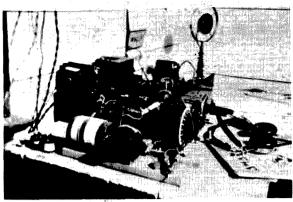
and QSL mean, but beyond that you both lose interest and hit the 'CQ DX' trail again! You don't give a tinkers' damn apparently if only the other guy will keep his promise and send you a QSL card!

You present day DX'ers can't be blamed too much though. Just try and do a little yakking with a rare DX station and you won't last long enough to get as far as".. rig here is home-brew..." before the thundering herd is loosed from its corral in all its fury; you 'have no business holding the guy; we too want a chance to tap him on the shoulder and then pass quickly on to spoil another QSO'!

And the gear you used to make your contacts in the late 30's? Receivers weren't too often 'store-bought' although a goodly share of them were pretty much available on the market. Kits were not as yet a factor in ham construction but a lot of good ol' home-

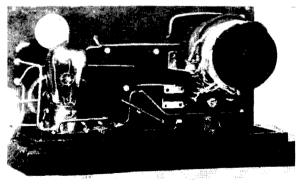


Equipment such as this shown here represented the popular version of a typical ham station of the early thirties.



In the 1920's, and even into the early thirties, vacuum tube transmission was being accepted with a tongue-in-cheek attitude and many stations were somewhat crudely assembled for "experimental" purposes.

brewing was done. The 30's weren't 'high salaried years' by any means remember; laying it on the line for factory-made gear came pretty tough and it wasn't too popular. It was a case of build it if you could, buy it if you had to . . you could get time payment deals even then. Transmitters? Another story: darned few were found with commercial factory labels on them . . home brewwas almost invariably the rule. Building your own was relatively inexpensive then. The urge for power hadn't raised its sneaky head with the idea that it took a full kW... even more if you thought you could get away with it . . . to mow down the mob and insure contacts for you. In the 30's, a guy with 100 watts or even less was in the top group of DX chasers more often than not. Two or three hundred watts was found only among the 'plutocrats' . . . the guys with wallets fat enough to afford the parts,or the *really* exalted beings who could lav it on the line for a shiny, factory-made blast-



Low-power rigs such as this five watter using a UV-202 tube established some remarkable DX records and played a large part in definitely establishing the superiority of tube transmission over that of spark equipment.

er that would insure *his* position as 'King of the Air Waves', to the disgust and detriment of thousands of fellow hams. The modest power boys were every bit as capable of posting up a DX score as the kW kings if given an equal chance at 'air rights'! Skill, not power, then as now, was the secret of DX contacts that really meant something.

Antennas? Beams were being played with, it's true, but the more popular conceptions of an effective antenna system embraced Zepps, Windoms and often a simple, random length of wire sometimes sporting a 'counterpoise' beneath it; a carry-over from earlier days when an antenna without a counterpoise just wasn't mentioned in the exotic circles of 'upper hamdom'!

Strange as it may seem to you mods, an awful lot of impressive DX work was accomplished then. While my best DX (never exceeded since!) was a bit earlier than the period we are discussing, it was representative. I made it to Moscow, Russia for a report of 'QSA 5, R 4, T near de' which was how we reported it then. This was in 1931 and I still have the card to prove it! And . . I was using a home-brew rig, parallel 210 tubes in a Hartley circuit running 40 watts input. This was on 40 meters and the antenna was an eight wire flat-top 30 feet long against a water pipe ground. I wasn't alone; a lot of my buddies did as well with as crude an assortment of gear. My receiver was still the little Reinartz I had home-brewed in 1922. I was afraid to tackle building one of the relatively new-fangled 'super-hets' and a factory built super was incompatible with a thin wallet!

I'll grant you that in the 30's the ORM problem was considerably less. We had, as I recollect without researching the files, perhaps half as many hams as we have now. Remember too, there was no novice license then which now offers an easy entry into the ham fraternity. You had to make it for the equivalent of the present day General class before you could touch a finger to the key! Consequently, hams entered the fold more slowly and although the growth was healthy, it didn't sky-rocket as it did following the radio training acquired by many in World War II and later establishment of the novice class. Right now, it seems, entry into the ham radio ranks has taken a little dive and new hams aren't being born quite so fast. No really plausible reason seems to have

been put forth, but I'm inclined to go along with those who feel that very likely the creation of the Citizens' Band, requiring no knowledge of code or theory, no exam of any kind, has done a lot to drain prospective hams from the list. Maybe that's good . . maybe not. Fewer hams . . less QRM, theoretically. However, from a practical standpoint, I doubt if it would be noticeable on the air.

So Wayne, does that give you a little rundown on what she was before the great influx into the DXpedition field? Personally, I'm content to rest on my meagre past 'laurels' in the DX field, lurk in the upper ends of the 'CW only' bands and catch the unwary now and then for a nice comfortable QSO without a horde of vicious jabbers laying for me . . hi!W7OE

YLRL 5th International Convention

The Colorado YL Club will play hostess to the 5th International YLRL Convention in Denver, Colorado, June 13-16th, 1968. This promises to be a great convention and it is not too early to begin planning. This takes place just a week after the ARRL National Convention in San Antonio, Texas, so perhaps the OM can be talked into the idea of a combined convention vacation.

Past experience has shown the Colorado YLs to be a group who have tremendous spirit and a cooperation rarely found in any club. There are no "tag-alongs" in this group. Everyone works, and hard! The gals promise a fine affair with the donation prize being a thing called M&M . . . with due appologies to the candy company. In this case, M&M stands for "Mustang and Mobile". A 1968 Ford Mustang complete with a mobile rig and antennas will be given away. If you prefer, you can take \$200 cash in place of the mobile rig.

There will be fine accommodations, fine food, tours, lectures, and special events for the OMs (including a tour of the Coor's Brewery). For further information and/or reservations, contact Marte Wessel KØEPE. Marte can be found at P.O. Box 756, Liberal, Kansas . . . or on 14.265 each Thursday at 1800 GMT on Tangle Net.

I'm going to be there, are you? The gals have a slogan going . . . "Don't Forget Our Big Date, YLRL '68" . . . WØHIL.



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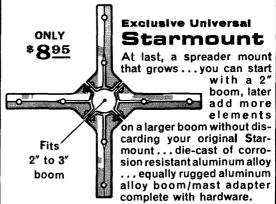
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DX'ing

Some more hints on chasing DX and how to get the most out of your station and your time.

Getting Through the Pileups

Both guile and experience are helpful when you face the impromptu DX contests that develop when a rare DX station suddenly comes on the air. If you have a sufficiently loud signal and it is bouncing into the right spot you can use brute force to get through. If propagation is poor, or your own station is a little weak, you have to substitute brains for brawn and clever your way into the contact.

Those of us afflicted with the need to work new countries spend a lot of time tuning the bands just listening. I think most of us, on twenty meter sideband, use about the same system. We start tuning at around 14,190 kHz and work our way slowly up the band, stopping at each station for a few seconds to see who he is or with whom he is talking. This gives us a good idea of just where the band is open to and from that we keep in mind what countries we might be on the special lookout for in that area.

As we tune on up the band we will, now and then, come to a pileup. We hear many stations all on the same frequency calling someone. Note first what call they are calling, if they happen to be giving the call. This is your first hint. Now and then they will be giving their own call and won't bother to say who is being called. You have to listen a little more in this case. In extreme cases like this I've been known to break in on the frequency and ask who everyone is calling. Someone will usually oblige.

If you notice that the stations calling are not all exactly on one frequency, then you know that the station they are calling is off the channel somewhere. Try tuning for him between 14,190 and 14,200 first. You have to know his call to know which direction to point your antenna, don't forget. If he isn't there then you might try listen-

ing down around 14,100 to 14,110. Some DX peditions operate down at the low end of the DX phone band. If you still hear nothing, check again on the calling frequencies and see if you can find a fellow who has made contact and see what report he is giving. This gives you an idea of how weak a signal you are listening for.

It is worth while to tune up from 14,100 to 14,200 once again, carefully listening for the DX station. You might also check about five or ten kHz below or above the frequency where most of the stations are calling him. If you still haven't discovered him, then break in on the pileup and ask what frequency the DX is on. After two or three calls someone will probably break in and tell you.

Be sure to split your transmitter and receiver, if you are using a transceiver, when you call a DX station that is out of the band. Every now and then you will hear someone who has forgotten to do this, break in on top of the DX and call him. Usually someone else will break in also and tell him to get back in the U.S. band.

If the DX station is outside the band and indicating that he is tuning a range of frequencies for an answer you should listen carefully for the fellow he is working and put your transmitter on that frequency and be ready to call when he signs with the other station. Don't try to break in while the other chap is still talking unless you hear the DX station accept this from others. This is normally considered impolite. You can try "tail ending" and see if that works. As the other station is turning it back to the DX station you can break in quickly and give your call letters. This often works. The major problem facing the DX operator is getting call letters through all the interference. If yours come through clearly, he is very likely to work you. And as long as the DX station is not on the same frequency as you, you won't be interfering

with him.

Take your cues from the DX operator. He will soon let it be known if he likes tail ending or breaking. These can be just fine if there aren't too many stations trying to get through. What is OK for a dozen stations can be bad for a hundred.

If you try to make it on someone's coattails and fail time and time again, then see if you can figure out the pattern of tuning the DX op is following. He may tune up the band and then go back to the bottom and start over. In any case it behooves you to try not to be on the same frequency as anyone else you can hear.

One of the worst operating systems is trying to get in the last call on a frequency. This happens most often when the DX station is transceiving and everyone is right on his frequency. Then we have the spectacle of fellows calling him one after the other with no one stopping long enough to see if the DX station has answered the call. I've heard fellows call a DX station for ten minutes straight, with two or three stations alternating the call and not taking a moment to listen.

Continuous calls can only happen when the DX operator is inexperienced. If the DX op knows what he is doing he will never permit anything like this to develop. The whole situation is really in his hands. What should he do to stop this business of longer and longer calls on his frequency? Well, this comes when the fellows trying to get him find out that he is listening on just that one frequency and that the DX station is waiting until he hears one call come through clearly. Once they find this out they try every way they can to be the last one to call. And this is bad news for everyone involved.

One of the experiments I've made in my travels to many rather remote spots, has been a trial of every system of working stations from a DX location. I wanted to find out which system really worked the pest. Of course, with English being my native tongue I have an advantage over someone with just a recent acquaintance with the language. I can hear call letters a lot easier and faster. After trying every idea I could find for working stations as fast as possible, I settled on the one which seemed to fill my log the fastest.

Perhaps my concept of working DX is a little different from others. I feel that a

station in a rare spot has a sort of obligation to give everyone who wants a contact a chance to say a quick hello so that a QSL card can be exchanged. And when you are just working stations as fast as you can, I feel that all of the wasted motion should be cut to a minimum. When I fire up, I exchange signal reports and call leters . . . nothing else. Names are important only if you are going to be talking with someone for a while . . . ditto locations. And why waste time telling me what transmitter or antenna is being used? By keeping the extraneous down I find that I can manage about four to five contacts per minute. This is about 250 per hour. Actually I usually only contact about 200 an hour because I take time out now and then to give my QSL address and to explain my method of operation. These general announcements every few minutes keep the questions to a minimum.

The system whereby the DX station is on one frequency, usually just out of the U.S. band, listening for calls either on one frequency or over a band of frequencies, usually results in about two contacts per minute average. It has the disadvantage of spreading the interference over a wide band of frequencies and thus raising hob with quite a number of other contacts on the band. And you get a lot more interference because so many fellows are not sure when to transmit and when to listen. This is, to my mind, an inefficient and messy way to work DX. Also, this system favors the louder stations and acts to frustrate the weaker ones who are forever getting clobbered by the big signals.

Another system, which works a little better than the above, but still leaves a lot to be desired, is to ask the calling stations to spread out over a band of frequencies and call for a fixed period of time, say two minutes. The DX op then writes down all of the calls he has heard and proceeds to work them on his own frequency as fast as he can. This causes massive interference to the band for a two minute period every few minutes. It isn't a very good system, either.

The method which proved the best to me was one that few others have had success with and thus have been afraid to really try. This is working transceive right on your own frequency. Let me explain the advantages of this type of operation before I



Herb Schoenbohm WØVXO standing on the imaginary line between PJ5 (rare) and FS7 (rarest). His operation from Saint Martin on 160 meters gave W1BB country number 97 on 160 only! This DXpedition earlier this year made stops at PY1NFC, OA4O, FG7XL, VP2AZ, VP2MK, VP2KY, FG7XL/FS7 and WØVXO/KV4.

go into the details . . . and it is the details that make it work where most others have failed with it. When you are making all contacts right on your own frequency you cause the least amount of QRM to the rest of the band. All of the fuss is on one single channel. It is up to you, the DX station, to keep the fuss to a minimum. If you sort out the calling stations properly you will find that you are able to contact even the weakest signals. I often contact mobile stations from just about anywhere in the world . . . fellows who have seldom before been able to work any rare DX because they are not able to brute force their way through the kilowatts. And, since I am able to work stations so fast, no one has to wait any great length of time to get through to me. There is none of this four or five hour calling that some DXpeditions have inflicted on the never-say-diers. I find that it is rare indeed when anyone has to wait more than 20 minutes for a contact . . . and he just has to sit and wait, not call frantically during the 20 minutes.

The whole basic secret is to, first of all, make sure that everyone trying to get you knows that you are listening for one call and one call only. If you don't get the call letters on the one call they are to wait for you to give further instructions. If you get this idea across you will be able to handle the pileup even when your own signal is fairly weak. If anyone starts taking too long to call, just break in on top of him and the others will straighten him out

quickly for he will be interfering with you. And don't ever take anyone out of turn. Do not accept a call from a breaker or a tail-ender. Explain that disorderliness will result in a mark in the log that no QSL is to be sent for the contact. Perhaps that is too drastic? Then threaten them with a one year hold up on the QSL for offenders. This is your strong weapon. Try not to get mad when someone is nasty or inconsiderate. Frankly I was astounded at what little problem I had with fellows not following my instructions. The DX'ers will cooperate beautifully when they understand what you want and see that it is to their benefit to cooperate. The DX station who wants to make long winded contacts and just two or three stations a day is going to have a miserable time of it.

Now, to the heart of my "system." I try to find out what areas are coming in strong and which are weak. Those which are fading out, I usually try to work first. It is very frustrating to hear a DX station that you want to work gradually fading out and have no chance to get through to him. The loud stations will be around for a while and you can get them easily. The weaker ones may be gone in 15 minutes. I always explain this in order to let the loud stations know why they have been put aside temporarily. Now, when asking for stations to call, I tell them about the one call rule and then stand by for a call area . . . say the first area. If there are too many stations calling to sort out any call letters I divide the pile up by asking for separate prefixes. I start with the newest prefix first. I've found that if I stand by for Wl's that I will get called by W1's, K1's, and WA1's. If I stand by for WA1's, the W1's would rather die than call. Normally there are not enough calling so I can't pick out one call . . . or at least part of the call . . . and then I ask for more WA1's until I have them all contacted and there is no sound when I stand by for more WA1's. Each station gets a signal report from me and nothing else.

When the KI's and WI's have all been worked I usually stand by for any late arriving first call area stations just to clean it up. One or two show up. When they have been contacted I explain again about one call, my area by area system of contacting, where to QSL, and then ask for second call area calls. If there are more

than a couple I split them up by prefix again, starting with WB2. Particularly weak stations are helped by others who want to speed things up for you.

Every now and then another DX station will break in while you are working. They usually wait their turn patiently too. Many times I've had an HK4 come in when I asked for fours to call . . . or an HB9 when I asked for nines. But generally I try to make the foreign stations feel wanted by standing by for calls from outside the U.S. every now and then between call areas. When there were heavy concentrations of DX stations calling I found that my system of dividing them up by prefix worked almost as well as it did on stateside contacts. You may run into a little trouble now and then, as I have, with stations who are not fluent in English and who do not understand what you are asking them to do. It is easier to work these as they come rather than argue with them. These are usually in Italy and Russia, for the most part.

Well, there is the whole system. If you get to a DX spot I hope you'll remember it. And if you run into a DX operator, hopelessly floundering under the QRM, you might try to get the idea across to him of getting calling stations to call just once and in call area rotation . . . with absolutely no exceptions. There is a great temptation to come back to a breaker who comes through very clearly. You ask if there are any eights that you have missed and a W4 comes through beautifully, giving his call. I write it down and ask him to wait his turn. Then, when I am back to the fours, I give him his report first, rather than making him call again. This speeds things up and few listeners realize what has happened, so I don't run into much breaking like that.

Using this method of operating on side-band, you should be able to get some 2000 stations in your log in an average day of about ten hours. By the time you have 5000 contacted you will find the stations thinning out and you will be reduced to calling CQ, sometimes without any answers. It is a shame that so many fellows in rare spots are wary about getting on the air because they get jammed up with so many calling them. Just a few days of hard work would get everyone off their back. From then on they would be able to talk as long as they like without being bedeviled by

"Second Annual 160 Meter International DXpedition"

FG7XL

Guadeloupe

Herb Schoenbolun - WØVXO op.

"Second Annual 160 Meter International DXpedition"

VP2AZ

Antigua

Herb Schoenbohm - WØVXO op.

"Second Annual I60 Meter International DXpedition"

VP2KY

Anguilla

Herb Schoenbohm - WØVXO op.

"Second Annual 160 Meter International DXpedition"

VP2MK

Montserrat

Herb Schoenbohm - WØVXO op.

More evidence of WØYXO's recent DXpedition into some of the rarer areas in the Caribbean.

breakers for a QSL card. We'll go into the QSL card situation later on. Let me just say that no DX station should ever limit his contacts because of the work involved in making out QSL cards or the expense of the cards or the postage involved. All of this will happily be taken over by a volunteer for you who will act as your QSL manager. The only responsibility of the DX station is to make contacts and send a copy of his log to the manager.

Getting The Time Right

One of the big miseries for DX operators is trying to verify a contact in their logs. About one third of the fellows who send them a card get either the date or the time of the contact wrong . . . or even both. This means troubles. The DX op then has to take his choice . . . try to find the contact in the log, a process that can be very time consuming if he has worked a large number of stations . . . or he can return the card for a better time or date . . . or he can just throw it out. The latter procedure is popular, unfortunately. The next time you don't get an answering QSL you might just take a critical look at your time and date keeping and see if that is the problem rather than the other fellow.

Probably the best thing you can have in your shack is a clock that indicates the time and date in GMT. These are a bit expensive . . . perhaps you can get by with just a GMT clock. I highly recommend the kind with numbers that come up rather than the usual hand type. You can read it a lot faster and there is less likelihood of reading it an hour or five minutes wrong. I particularly like one of the matching consoles, that goes with my transceiver, which has a clock, loudspeaker and phone patch built in.

It doesn't do a lot of good to have the time right when the date is wrong. I don't know why so many fellows have trouble with this, but they sure do. Keep a calendar by the operating desk and try to remember to write in your log the date when you start operating and to note the change of date as 2400 slips into 0000 hours.

Your power company may be completely reliable and once you set your clock it may be giving the correct time from then on. But, unless you are positive that there couldn't have been a short power failure, it won't hurt to tune in now and then to one of the time standard stations. This means WWV or CHU for us here in the U.S. WWV transmits, along with WWVH in Hawaii, on 2.5, 5, 10, 15, 20 and 25 MHz. You can get a time check from them every five minutes. And you should be able to receive at least one of these stations any time of the day or night from anywhere in the country.

While I don't want to appear dissatisfied with the American product, I will admit a partiality to the time signals from the

Canadian Observatory via CHU. These come to us on 333 kHz, 7333 kHz and 14,460 kHz. CHU gives you the correct Eastern Standard Time every minute, complete with both voice and CW announcement. Their 7333 channel is usable in most of the U.S. during the day and can normally be copied on ham transceivers. WWV channels usually require an all band receiver since they aren't near any ham bands. Of course, in this day of transistor portables I guess that most of us have a little short wave receiver lying around which can copy at least up to 12 MHz.

Some operators are still using their local time for keeping their logs and this then gets on the QSL cards. Picture yourself in Singapore trying to equate Mountain Daylight Time with GMT so you can locate the contact in your log. If the chap has the patience, he will be on his way to losing it along about the tenth card he gets like this. Moral: keep your log in GMT. This is the world standard, so why try to pick a fight with it at this late date?

It will be handy for you to keep some sort of time chart around the operating desk. The great bulk of the stations all over the world are active on about the same pattern. They often try for a few minutes when they get up in the morning, then you'll find them on the bands after they get home from work in the evening. After dinner, many of them will show up for a while. If you are looking for contacts with the Pacific Islands there is little point in making much of a fuss about it during the middle of their afternoon . . . they are all at work then. But if you check to see what time six in the evening for them is in your time zone, you will stand a lot better chance of getting a contact. Give a check around 8 am their time too. The prime time is from 8-11 pm, providing you find the band is open to that area during that time. You might consider buying one of those world maps which indicates the times in most places of interest. They have a tape which runs past the windows to show the local times.

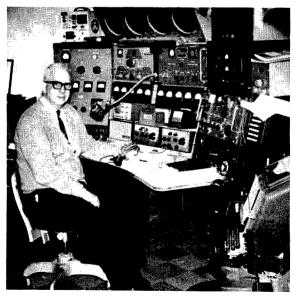
On weekends you are likely to find stations operating at any time. This is the best time for the late night openings on the lower bands in particular. And when the sun spots are perking well, you will find twenty meters open all night much of the time.

. . . W2NSD

WTW Report

Things are coming along very fine with many fellows interested in the WTW. More are qualifying all the time, getting low serial numbers on their certificates. OSL cards from the DX stations are coming in pretty well now, and it's certainly possible for almost anyone who halfway tries, to get 100 confirmed countries. The WTW country list is reasonably generous since our interpretation of what is and what is not a country depends completely upon the national amateur radio societies of the world. I suggest that those who are interested drop me a line, enclosing 25c in stamps, and I will send along a few sets of our country list. Each list consists of four pages, printed on both sides, with space for you to use them as a tally sheet for ten years. You will need two sets for every mode you are interested in trying for since we want one list sent to us and you retain your copy of what you sent in. This will make our records the same as yours and simplify our joint tasks later on. Just send me 25c in stamps to cover postage and handling.

As you might expect, there are some mistakes in the country/tally sheets with a few countries overlooked in making it up. Please make the following corrections to the WTW country lists that you have: JW prefix for Bear Island, JX for Jan



"Hop" Hopple, W3DJZ, winner of WTW-200 Single Sideband certificate number 2.

Mayen. The first KG6 should be Marcus Island. On page 2, the second country listed should have the prefix of FO8M for Maria Teresa. Last one listed on page 2 should be JW for Svalbard.

On page 5, after VP2M, enter the letter "K" in front of St. Kitts and Nevis; in front of St. Lucia enter the letter "L" making the prefix VP2L. In the blank space before VQ7, 9, enter VQ9 as Seychelles Islands. In the last blank space right after VS9A, enter VS6 for Hong Kong. On page 6, please note that ZS2M is both Marion and Prince Edward Island and is only one country. This seems to be all the changes necessary to the list. Of course, the exact way to spell some of the countries may be wrong, but it depends upon who is doing the spelling. Hi. I have seen so many different ways that they themselves spell the name of their country, that I am sure the way I have spelled them you know what place I am writing about.

To save me lots of work, please send to the following fellows/associations if you want a few sets of the WTW country/tally sheets, and, when you have qualified, send your QSL's to them to be checked:

W/K 1: We are still looking for a good club to handle this district. Until one is found deal directly with me-W4BPD.

W/K 2: Same as above.

W/K 3: Western Pennsylvania DX Society, John F. Wojtkiewicz/W3GJY, 1400 Chaplin St., Conway, Penna. 15027.

W/K 4: The Virginia Century Club, P.O. Box 5565, Virginia Beach, Va. 23455.

W/K 5: Same as W/K 1 and W/K 2.

W/K 6: Orange County DX Club, James N. Chavarria, 3311 Sterns Dr., Orange, Calif. 92666.

W/K 7: Western Washington DX Club, Inc., Wm. H. Bennitt (W7PHO), 18549 Normandy, Seattle 66, Wash. 98100.

W/K 8: Straits Area Amateur Radio Club, William Moss/WA8AXF, Petoskey, Mich. 49770.

W/K 9: The Montgomery County Amateur Radio Club, Scott Millick/K9PPX, Box 250, Litchfield, 1ll. 62056.

W/K Ø: Same as W/K 1

All of Canada: The Edmonton DX Club, (VE6GX), 12907 136 Ave., Edmonton, Alberta.

Oceania: The New Zealand Association of Radio Transmitters, Jock White/ZL2GX, Contest & Awards Manager, 152 Lytton Rd., Gisborne, New Zealand.

Hawaii: Use the K/W 6 verification club

(Orange County DX Club).

South America: Venezuela Amateur Radio Club, Attention of YV5CHO DX Committee, P.O. Box 2285, Caracus, Venezuela, South America.

Europe: R.S.G.B. (Radio Society of Great Britain).

Africa: Same as W/K1

Asia: Presently same as WK1. We are working on one of the large Asian DX associations now, and will let you know if we can get together.

What with the wonderful conditions these days, I am sure that there's a lot of fun to be had if you enter WTW seriously. I

have had some complaints about the QSL problems some of you are having. About the only comment I have about this is—you have not worked the right stations or your approach to the QSL card problem has been wrong. This is borne out by the fact that too many other fellows have received QSL's for their contacts; look at all the fellows who have the QSL's and have qualified. There are quite a few over 200 already confirmed and working towards WTW-300. Mind you, this in only the first year. It can be done!

I can use a few good black and white photos with a little background from some of you who have qualified. I would like to have a story about you and your station to run in a future issue of 73. That's it for this time fellows . . .

W4BPD

Worked the World

14 MHz SSB WTW-200

- 1. Gay Milius W4NJF
- 2. "Hop" Hopple W3DJZ
- 3. Dick Leavitt K3YGI
- 4. Joe Butler K6CAZ

14 MHz SSB WTW-100

- 1. Gay Milius W4NJF
- 2. Bob Wagner W5KUC
- 3. "Hop" Hopple W3DJZ
- 4. Bob Gilson W4CCB
- 5. Jim Lawson WA2SFP
- 6. Joe Butler K6CAZ
- 7. Warren Johnson WØNGF
- 8. Lew Papp W3MAC
- 9. George Banta K1SHN
- 10. Dan Redman K8IKB
- 11. Paul Friebertshauser W6YMV
- 12. Jay Chesler W1SEB
- 13. James Edwards W5LOB
- 14. Bill Galloway W4TRG
- 15. Olgierd Weiss WB2NYM
- 16. Jose Toro KP4RK
- 17. Gerald Cunningham M1MMV
- 18. Edward Bauer WA9KQS
- 19. Dick Tesar WA4WIP
- 20. G. "Gus" Brewer W4FPW
- 21. Jack McNutt K9OTB
- 22. Charles R. Sledge W4JVU
- 23. Ira C. Crowder DL5HH
- 24. James Leonard W4FPS

25. Richard Leavitt K3YGJ

- 26. Gordon Read VE6AKP
- 27. Paul Haczela K2BOO
- 28. Don B. Search W3AZD
- 29. Len Malone WA5DAJ

14 MHz CW WTW-100

- 1. Vic Ulrich WA2DIG
- 2. James Resler W8EVZ
- 3. Dan Redman K8IKB
- 4. Robert C. Sommer W4CRW
- 5. John Scanlon WB6SHL
- 6. Newton W. Gephart W9HFB

21 MHz SSB WTW-100

- 1. Ted Marks WA2FOC
- 2. James Lawson WA2SFP
- 3. Joe Hiller W4OPM
- 4. Scott C. Millick K9PPX
- 5. Paul Friebertshauser W6YMV

21 MHz CW WTW-100

1. Joe Hiller W4OPM

28 MHz SSB WTW-100

1. James L. Lawson WA2SFP

7 MHz CW WTW-100

- 1. Rex G. Trobridge W4BYB
- 2. R. Sigismonti W3WJD

Gus: Part 28

Bouvet Island

About the 2nd or 3rd day out from Gough Island, the first iceberg was spotted. Just a cold, white hunk of ice floating in the sea. The first one looked to be about the size of an automobile, and they tell me that only about one fifth of it is above water. The further South we went, the more icebergs were seen. You can be sure that they had their special iceberg spotter sitting on the radar all night long.

That night, I went out on deck as usual and the old Southern Cross was nearly overhead. We were getting there, and the winds had that icy feel when they struck me in the face. The next morning when I went out on deck for my usual look around, the sky was completely overcast and it was downright cold, with a capital "C". That was when I went back to my little cabin and hauled out a pair of those "long handles" that K8TRW had sent me, and when I went back out on deck, I felt a lot more comfortable.

All during this part of the trip, I spent as much time on the bands as possible to give the fellows a running account of our progress to the island. I think it would make DXpeditions a lot more interesting if every DXpeditioner would do the same thing. This gives the fellows a chance to follow your progress as you get near that rare spot. I suppose this is what you might call part of the "chase." As you get nearer and nearer to the spot, the fellows will know approximately when they can look for you from the island. This gives them a chance to phone the boss to pull the, "I am sick", deal. I think this is much better than just popping up from some spot without warning and making many of the gang miss you, unless they take off three or four days.

When we were about 100 miles from Bouvet, the sea was completely covered with ice floes. The little ice breaker just plowed into the floes and broke them up into smaller pieces as we went through. They told me about getting caught in the ice once in March, and had to have an American ice breaker come to their aid and break a path for them to get out.

I think it was the 4th day out that we at last saw Bouvet Island in the distance. I got on the air that night and told the boys

that I had at last arrived and hoped to land the next morning. I had found that it was sun-up at about 2:15 AM (local time, that is) down there. I got into the sack for a short night's rest at about 11 PM. I was too excited to do more than get an hour or so of sleep before they woke me up to say, "This is it...let's go".

Everything was loaded into the big lifeboat, very carefully wrapped in canvas and oil cloths and secured with rope to keep it

from sliding all over the boat.

We had found a spot on the map which was on the northwest corner of the island, called "Circumcision Point". Just the right spot for propagation to the USA, Europe, Africa, South America, and even some of Asia. But, the VKs and ZLs were very well shielded by sheer cliffs, both to the south and southeast. This spot was about the size of two city blocks and was well above high tide.

It took about two hours of hard work for us to go the 1000 feet or so from where the ship was anchored to where we wanted to land. The temperature, I estimate, was about 20 degrees and the wind was absolutely murder when it struck me in the face. I had on the following clothing: regular undershorts and shirt, then two pair of those red long insulated underwear, a flannel shirt with long tails, two pair of woolen pants, one pair of regular socks, and then a pair of woolen socks coming about 6 inches above my knees . . . then a very heavy turtle neck sweater. I also had a wool headpiece covering all but my eyes, and a big heavy overcoat and last but not least, a pair of fur lined gloves coming almost to my elbows. And I was still cold!

Getting all my stuff ashore was no easy task and to this day I'm surprised we didn't lose some of it in the rough swells which kept hitting us. But we made it . . . I was at last on Bouvet!!!

I had an African chap, and lots of penguins to keep me company. We had lots to do after the lifeboat departed. A tent to put up, an antenna to install in frozen ground, the putt-putt to get cranked, a fifty gallon drum of petrol to roll up to the point I had selected for it, a tank of compressed gas,

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coils, lenses, economical vidicons, tripods and other essential TV items. FACTORY-DIRECT

Broadway

Dakota City, Nebr.

and even a small gas heater had to be moved to the camp site.

At last I had arrived at this bleak, frozen, ice and snow covered island some 1,500 miles southeast of Capetown, South Africa. We were there in what they call mid-summeraround the fifth of December. The ice pack was some 150 miles or so north of the island, and it took a South African ice breaker to get through all that frozen ocean. I sure would hate to try going there in a smaller boat even in their "warm season".

The island from a distance looked like a very large chocolate cake with white frosting on its top side. The top of the island (at least about 9/10ths of it) is a high plateau, and this portion was covered with a glacier some 200 to 300 feet thick. This glacier was making all kinds of noise all day long and all night long; cracking, popping and snapping. Then there was a tremendous splash when a big chunk of this frozen snow dropped off to the ocean below. These chunks at times were as large as two or three moving vans.

When the bands quieted down, it was interesting to watch and listen to things happening to that ice. But to me the penguins and other bird life were even more interesting, as well as a number of seals and sea lions which hung around all the time. At times these sea lions would have a fight and what a lot of roaring and grunting took place! Trying to count the penguins was an impossible task since they were always on the move. At first they were very friendly, in fact this business of being friendly was the biggest trouble with them. It got to the point where we became the center of attraction to them. They were not afraid of us at all, even when we had to use a small piece of aluminum pipe to keep them a distance away from us. Everything we did there was difficult-did you ever try driving a piece of aluminum pipe into frozen ground? Well we finally got it down, not too deep of course, but when we got ready to depart it was frozen solid and we could not get it out of the ground. It's probably still right there where we drove it in! Getting the tent anchors in that frozen ground was a little difficult too, even though they were made out of sharpened pieces of steel. We put up our little "pup tent", size about 4 by 6 feet. Not enough room for our two folding cots and the card table for the rig. This card table ended up being placed

at the entrance, when the flaps were extended, the operating position was about 50% shielded and about 50% out in the open. I operated with my folding chair right up against the end of the cots facing out, I was in the shelter, but the rig and most of the operating table was outside the tent. The antenna (a vertical Hy-Gain) was 33 feet from the rig and the "putt-putt" (power plant) was 250 feet away. After battling those doggoned penguins every step of the way we finally got everything put together and connected up. My hands were nearly frozen, even though I had on a pair of fur lined and covered gloves. You can be sure it crossed my mind that no one back in the states, in their well heated houses or apartments had any idea of all this happening to me. Even to this day, it's amazing to me that I stuck to the task, freezing, with teeth chattering, doing all this to give the boys another new country. The DXing bug must have given me encouragement to overcome all this and to put up with all this "ungodly" hard and miserable work to give the boys all over the world a little more excitement and something to chase again. I don't think there is a thrill in the world that's more exciting than to be the center of attraction to thousands of DXers with all of them in there madly calling you for that "new one". I sure wish I had a better command of the English language so I could describe this feeling to you. If you are a true DXer and have snagged some new ones, you have just a small idea of how I felt at Bouvet as well as at the other Brand new countries I put on the air for the first time. Even right now, sitting here in Cordova, South Carolina, writing this article gives me another thrill, thinking about it again. Even with all the things that happen each day to make these events slide to the back of your mind, you still have time to lie in bed at night just before you go to sleep and think back on all these wonderful experiences. Up to this time I am quite sure that Bouvet island is the high spot on my list of experiences I have gone through, at least up to this time -of course later on putting Tibet, Bhutan, Sikkim, and even Red China on the air, almost exceeds the excitement of the Bouvet Island operation. Just like the Gough Island operation; right after the tuning up, there was ZS1RM (Marge-in Capetown again) in there, she just said (on CW), "Gus?" Back I came and said "vep, it's me Marge." Then

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the world fell in on me. More doggoned stations calling than I have ever heard, even up to this day of DXing. I had kept everyone well informed as to my progress on the way to the island by operating MM all the way from Gough Island until Bouvet was sighted. Since my "ETA" had been given out to the boys, they all were on hand, standing by for me when I fired up. Many of them I found out later had stayed at home, playing sick, or taking their vacations so they would not miss this one. I know, with all those thousands calling me every minute of every day I operated, that some of them never did make the grade-to these I say I am sorry —I sure wish I could have stayed longer. I did stay 4 and ½ days and operated practically around the clock while down theretotal number of QSO's at the end of that time was almost 5,000 and still the pile-up sounded larger than the first day there. It was great fellows! The thrill is still with me when I sit or lie back and think of it all.

The first night there was "something", yes sir. When the sun went down (about 10:30 at night), those darned penguins crowded around the tent when I turned on the light over the operating table, and it

was a continuous battle, with both me and the South African chap beating them off trying to keep them from coming into the tent. Those pretty little fellows, that look so tame and helpless, are real rough ones when they struck us on our legs with their little stublike wings and it was not beyond them to, at times, take a nip at you with their beaks either. We soon got to the point where it was no fun battling these creatures all night. I kept the South African chap rather busy most of the time pouring "petrol" in the "putt-putt", and trying to control the penguins. In between times he would crawl into the sack to keep warm.

The little gas heater sure did come in handy. When I was operating, I usually had an army blanket over both me and the whole rig; with a kerosene lantern burning between my legs to attempt to keep warm. The second night there we had a snow storm. It must have been a five or six foot snowfall. When it started falling and started to get real cold, the wind felt like it was directly from the South pole and the temperature fell down to about 15 degrees (F). To me, it felt like minus 15, and snow came down it seemed in

Knight-Kit T-175 6/10-Meter Linear Amplifier



With the tremendous band openings on six and ten that are due this winter and next, a little extra power will help in getting through the QRM to work that new country or state. If you're presently getting along with a one-to ten-watt peanut whistle such as the Knight-Kit TR-106, the T-175 linear amplifier is ideal. It is particularly useful with small transistor transmitters where you want a little more zap.

In addition to operation as a grounded-grid linear amplifier on AM, SSB and CW, it may also be plate modulated for high-level AM operation. It will run 120 watts on AM linear and plate-modulated AM, 150 watts on CW and 300 watts PEP on single side-band. Drive requirements for AM are one to four watts, seven watts on CW and up to 15 watts PEP on SSB. These requirements fall right in with several low-power trans-

mitters and transceivers currently on the market.

Although the T-175 linear is not a bandswitching unit, it may be used on either six or ten meters by simply wiring in the proper final coil during construction. By using a coil which is designed specifically for the band in use, efficiency is considerably increased over a bandswitching arrangement where design compromises must be made.

When I first built the amplifier, I put in the ten-meter coil so I could run some comparisons with a popular five-band 300-watt sideband transceiver. With about 10 watts of SSB drive, I could load the T-175 up to the same power output as the transceiver. The DX stations I worked couldn't tell the difference when I switched from one unit to the other. A quick check with the scope showed no flattopping or distortion

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"chunks"—it was so darned cold, I just QRT, and to keep warm, crawled into the sack, putting the little heater at the foot of our cots and closing the flaps. The heater was turned up "wide open" and I was so doggoned tired I am sure I was sound asleep in about 2 minutes. I had set the alarm clock to go off at 5 AM the next morning and I am glad to say I am a very light sleeper. I think the bell on the clock clanged about once and I reached over and turned it off and leaned over and turned up the lantern which had been burning all night. I intended on going outside to crank up the putt-putt and get going on the air. I found that I could not even open the test flap! I woke up the helper in the other cot, and we both finally got the tent flap open and found that the tent was almost covered with snow. It was broad daylight at this hour down there, and the sun was up nice and bright. We went out to the power plant, and after trying about 15 minutes we could not get it cranked at all. Then we drained out all the oil and took it back to the tent and put it over the little single burner gasoline stove to get it about to the boiling point. We rushed it back to

the power plant and poured it in quickly and then primed the engine by pouring raw gasoline directly into the spark plug hole. The very first pull on the cranking cord, she started off and I was back in business as LH4C! I went back to the Rig and found the SWR up to about 5:1 then it dawned on me that the snow had the antenna base drowned-we practically dug our way to its base and found the snow about 4 feet deep and away we went with our snow shovels and removed the snow from around the antenna (we did not worry about the ground plane radials being covered). The first "One by one CQ" produced the right results-sounded like a thousand fellows calling me-and before that first call I had only heard two stations having a rag chew. Everyone must have been standing by just for mel-The "Gus watchers" were really on the job that morning. Everytime you worked one, it seemed two took his place and the pace never did seem to slacken even up to the last day of operation. Nothing like this had ever happened before, and to this day I still get a thrill thinking about it all.

. . . W4BPD

when driven with the low-power exciter, but when drive exceeded about 15 watts, some distortion was discernible (on sideband).

Linear AM operation is much more critical than sideband, but when the T-175 is tuned up according to the instruction manual and the grid bias is properly adjusted, there is no distortion. Of course, there is no problem at all with CW operation and when plate modulated with an external 60-watt modulator, excellent results (and reports) are obtained.

After extensive testing and signal comparisons on ten, I pulled out the ten-meter coil and put in the six-meter coil. I had been running a low-power transverter for local contacts on six, and the extra power afforded by the T-175 was a welcome addition. DX stations I had called in vain during previous openings often came back after the first call. Since I live in a channel 2 fringe area, I was a little concerned with possible TVI problems, but even with no low-pass filters installed I didn't experience any difficulty until I got above about 52.5 MHz; TVI problems above this point in the band were quickly eliminated with a Drake low-pass filter.

The circuit of the T-175 linear amplifier is quite straight forward—two horizontal deflection tubes (6JE6A's) are connected in parallel grounded grid. With class-B operation, excellent performance is obtained on AM, SSB and CW. A fan is included to keep things on the cool side and a pi network is used to couple into coaxial lines from about 25 to 150 ohms.

One extremely nice feature of this amplifier is the built-in relay amplifier (12AT7). With this tube in play, no external switching is required to turn the linear on when you go to transmit. A small amount of rf energy is picked off the input, rectified and filtered, and fed to the 12AT7 grid. Normally this tube is cut off, but when transmitting, the rectified rf signal turns it on and picks up the relay in its plate lead. This relay connects the driver to the grid circuit of the power amplifier, connects the antenna to the output pi network and turns on the fan.

If you want to operate the exciter barefoot, you simply put the control switch on standby. This disconnects B+ from the relay amplifier, thereby preventing the control relay from being activated. In this configuration, the driving signal bypasses the power amplifier and is connected directly to the antenna. The relay amplifier is also used for

Knight-Kit T-175 Specifications

requency range:		provided; 27-30 MHz
Power input:	and 50-54 120 watts	MHz. AM linear or plate-

Power input: 120 watts AM linear or platemodulated AM; 150 watts CW; 300 watts PEP SSB.

Drive requirements: 1-4 watts AM; 7 watts CW; 15 watts PEP maximum SSB.

Input impedance: 50 ohms nominal.

Output impedance: 50 or 70 ohm coaxial line. SWR less than 3:1.

Tube lineup: Two 6JE6A output amplifiers; 12AT7 relay amplifier.

Power supply: Silicon rectifiers. Fullwave volt-

age-double high-voltage supply.

Halfwave voltage-double bias

Halfwave voltage-double bias supply.

Features: Meters on front panel for plate

current and grid current/relative power. Forced air cooling during transmit.

Power requirements: 110-130 Vac, 60 Hz, 220 watts maximum, 45 watts on standby. Size and weight: 5½ x 13½ x 11 inches. 20 pounds.

CW operation, but above 12 WPM, the relay is too slow to follow the dots and dashes, and it must be continuously activated by a simple resistor substitution.

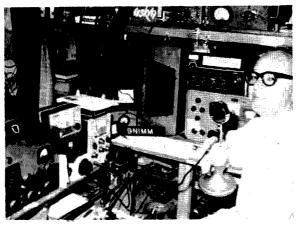
Construction of the T-175 linear amplifier is very straight forward and you shouldn't run into any difficulty if you follow the excellent instruction manual. All of the parts are clearly labeled and the hookup wire is provided in precut lengths. Proper layout on six meters can sometimes be a problem, but in the T-175 no trouble was experienced within stability or parasitics. The design is simple, efficient and trouble free.

During the time I have been using this linear amplifier on the air, all the signal and audio reports have been excellent. When running AM linear, some of the operators I have worked have been quite surprised to find that I was not using high-level plate modulation. Television interference complaints, even on six meters, have been nil and the extra power available has aided immeasurably in adding states to my six-meter list.

If you're doodling along with low power on six or ten, here's an easy and economical way to really work out. A few evenings work and a good antenna, and you'll have one of the best signals on the block. And, when you add up the cost of the parts in the T-175, it would be pretty hard to come up with a comparable homebrew linear for the same price. At \$99.95 it's a darn good investment.

Oh yes, it will work on the 11-meter class-D citizens' band too, but don't do it in the United States, it's highly illegal!

. . . W1DTY



Father Moran 9N1MM in his shack.

her and China. With the opening of the road and the airport things have changed completely. U.S. A.I.D. came in first and then Russia, China, Israel, and others came in to help. The U.S. seems to be doing a good job and there are some 200 Peace Corps members here . . . well thought of.

Bob, his wife Martha, and son Mike get their food from the American Embassy commissary. We had dinner at his house . . . roast beef, roast potatoes, cole slaw, and wine. It was a rather normal American meal . . . way up here in Nepal.

After dinner we drove to St. Xavier's School, set up by Father Moran in 1954. We dodged the sacred cattle and people on the narrow streets. Bob explained that if you hit either cows or people, it is best to keep right on going and go directly to the Embassy and let them sort it out. The people can get very excited and become a mob. Seems to me I remember they had this problem in India after the last war. Drivers would often be executed on the spot, even when an accident wasn't their fault.

Father Moran worked with Hillary on the Everest expedition, and made a very good



Bob and Father Moran.

name for amateur radio. Everest is about 15 days walk from Katmandu . . . there are no roads. But, in spite of the value of amateur radio, no one has been able to get official permission to operate except Father Moran. The attitude of the government seems to be the same as down in Afghanistan . . . go ahead and operate, just don't ask for a license. The trouble with this arrangement is that, if for some reason the Nepal government ever gets mad at some country they can then turn around and make a big deal about the illegal amateur radio station run by a national of the troubling country, etc. Bob would like to get on the air, but since he is attached to the Embassy he is afraid to take the chance.

The school is a lot larger than I had imagined. We took my bags up to a sort of monastic cubicle and then put 9N1MM on the air for a little bit. I worked a bunch of Europeans, but didn't hear a signal from the U.S. Ed, from Kabul was on and we had a short contact . . . also a couple of Japanese stations came through for a few minutes. Then the band went dead. The rig is a Viking with a Drake receiver and a three element beam up on the roof. It works out rather well, considering the remoteness of the location and the valley it is in. The U.S. is difficult to work from here, being across the North or South pole.

About six the next morning, one of the fathers walked through the school ringing a little bell to wake up the children. About 250 boys live at the school, another 200 live in town and come to school every day. There is also a girls school nearby for about 500 girls . . . and a high school just around the bend. I had awakened around 5 AM. For that matter I woke up a good many times during the night too. The bed I was sleeping on was not in any danger of collapse. It was made of very solid, hard planking and every bone in my body felt bruised. I rolled over and over during the night to distribute the damage as much as I could. Even after eight hours in bed I was tired clear through.

After some forty years of taking a bath every morning the beginnings of a habit seem to be forming. Here I found myself with the choice between a cold vat of water or no bath at all. I decided that I would rather feel scrubby than turn into an iced ham. They have not invented hot water here . . . unless you light the little kerosene stove and heat a pan of water on top of it. This

is probably for shaving.

Father Moran came by my room and explained that twenty meters was a bit weak this morning. I went to the radio shack and listened. The only U.S. station was W4PAA in Orlando. I called Jack a few times, but he wasn't listening very carefully. I chased every signal that managed to break through. Bob had left a cooler with some Coke in it the night before . . . plus some chocolate cake wrapped in aluminum foil. Breakfast was a long way off yet so I broke out a Coke and tried to open it with my Swiss Army knife. I got it open, but the knife went on through the side of the can, spilling Coke all over the table. I quickly put the can to my mouth to catch the flow of Coke and managed to slice both my thumb and my lip, adding a nice touch of blood to the meal. I grabbed a towel to sop up the Coke from the table and then went to the bathroom again to rinse out the towel. It wouldn't rinse out. The best I could manage was a rather nasty brown stain.

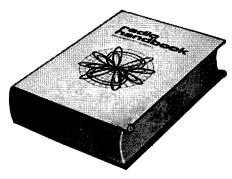
I also learned about eating cake from foil. The icing sticks to the foil and the cake crumbles all over everything. It was a mess . . . icing on both hands, on the Coke can, face, and shirt. The crumbs were in a three foot circle around me. By the time I got this all cleaned up the band was completely dead.

A little later Father Moran took me down to Bob's house again . . . breakfast of pancakes, scrambled eggs and sausage. That was the first real American breakfast I'd had since leaving the States two months earlier. I got to thinking that if they are living about the same as at home, they probably have a shower. They did, and I took one, complete with shave. I felt a lot better



St. Xavier's School in Katmandu . . . note three element twenty meter beam on roof.

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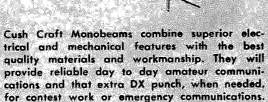
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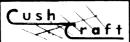
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The DXERS MAGAZINE c/o W4 BPD

Route I, Box 161-A, Cordova, S.C., U.S.A. and was now ready for the sight-seeing tour.

We all piled in Bob's Chevy. Bob wishes that he had brought over a Rover or Jeep instead of the Chevy . . . they have those kinds of roads over here. He could sell the Chevy for about \$5000 here, but the Embassy has a rule that anything over the original purchase price for the car must be given to charity.

Father Moran walked through the two or three blocks of the downtown area with me, pointing out things of interest for me to photograph. I'm afraid that some of the sculptures on the temples are much too graphic for our advanced civilization and I will have to keep the pictures of them for private showings. The city is very old and the stores are just little stalls along the sides of the streets. Most of the roofs have grass growing on them. And here and there are mats in the street with red peppers drying on them. Their curries must be every bit as hot as those in India.

We passed quite a few men and women walking into town with heavy loads on their backs . . . fruit . . . wood. These loads are worth about 3 rupees . . . 4e . . . and the wood they bring will keep a family in cooking wood for two weeks. These men bring their loads in from about two days out. They make the four day walk for about 4e. Everywhere we walk or drive we have to be careful to avoid the sacred cows and dogs sleeping in the streets. Bob explained that a few years back they decided to make the cows unsacred, but they disappeared into steaks at such a rate that they hurriedly made them sacred again to preserve them.

On a hill overlooking the town, we visited a temple and I took pictures of Katmandu in panorama . . . and the monkeys running wild all over the place.

Since I was supposed to take a late afternoon plane to Calcutta, we stopped off at the airline office in town to reconfirm my flight reservation. "So sorry, the schedule has been changed and you have just missed that plane." There was a flight tomorrow, so I would be in Nepal for two days after all.

After a lunch at Bob's, Father Moran drove me back to the school and I got on the air for an hour or so. Ray, VK3ATN was on and he had made arrangements for me to cut short my coming visit to Sydney by one day and come up to Birchip to see his two-meter moonbounce installation. They had made arrangements to have me flown by

private plane from Birchip to a city where I could get a commercial flight to Sydney. Since they had gone to so much trouble I couldn't let them down. I agreed to the change in plans, hoping the Sydney gang wouldn't be too put out.

The extra day in Nepal was welcome, except for the thought of that hard bed again. I'm just too used to soft living. The temperature is wonderful, about 75° during

the day and 70° at night.

I sat at the rig working stations as fast as I could until called for afternoon tea with the fathers who run the school. Then, after talking and teaing, back to the rig until time to go to Bob's for dinner. Steak, baked potatoes. Another American couple dropped by after dinner and we all sat around and talked until about 9:30 . . . bedtime. Father Moran drove me back to the school and I spent a fitful night listening to the mosquitos just outside the net around the bed, and turning over and over trying to find some unbruised bone from last night.

Just as soon as the morning bell was tinkled I headed for the shack . . . dead band. Not a whisper. The town power failed about 6:30 and never came on again while I was there . . . until noon. No one seemed to pay any attention, so I assume

that this is normal.

Breakfast at the school was a little more spartan than at Bob's, but it was American oriented with corn flakes and fried eggs. After breakfast Father Moran drove me down the road to see the Tibetan refugees. When the Chinese communists invaded Tibet, fifteen thousand people escaped into Nepal. Nepal ignored them and they were starving when Father Moran came to the rescue. He got the Swiss to furnish equipment for weaving, and to export their finished products to Switzerland for sale. They make beautiful carpets and jackets. I immediately bought a jacket for myself and have since seen them for sale, even in the U.S. Up in my hometown of Littleton, New Hampshire I spotted one of the Tibetan-Nepal jackets for sale in the Carol Reed Ski Shop.

The Tibetans shear the sheep, card the wool, spin the wool into yarn, dye the yarn, weave the rugs and cloth, and end up with the finished products. This is all done by hand in small buildings on the outskirts of Katmandu. This industry has saved these people from starvation. I was interested to watch the girls making the patterns in the



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REMEMBER THE 11-METER BAND?

It's active, as you know, if you ever listen in on the Citizens Band. In fact, there are more rigs on the air (some 3-million) in that 300-KHz slot than in any other part of the radio spectrum. And, surprisingly enough, many of the rigs are more sophisticated than many ham rigs.

To keep up with what's going on in the CB world, read CB Magazine, the responsible CB publication which contains articles on theory, the HELP program and all kinds of radio communications including ham.

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carpets. These are modern designs of the old dragon themes. They have a sample carpet in front of them and count off the stitches on each row. Each row is banged tight with a hammer so that these carpets are extremely solid. We stopped off in the shipping department, and I found that they get about \$40 for a 4 x 6 rug. I bought the jacket for about \$15.

We picked up my bags, paid a visit to the American Embassy where I saw a couple beatniks, complete with beards, worn trousers and bare feet . . . Americans, naturally. Even up here! We took time for me to have one more shower and shave at Bob's house . . . and then to the airport and Royal Nepalese Airlines to Calcutta.

Father Moran certainly did make my short visit to Nepal something which I would never forget. Before the trip I tried a couple of times to keep schedules with him, but I could never quite get him through the QRM. He said that he heard me coming through fine. Frustrating. The more I get a chance to operate in remote spots like this the more respect I have for the fellows with the power and the big beams. It takes a big signal to get through to here most of the time. Oh, you can make it a few days of the year with medium power, but you can get through almost every day with a big signal. Now, if only Father Moran had a good signal on his end!

On the plane ride to Calcutta, I noticed that they were playing very strange music. Could this be Nepalese music? Then, after I listened for a while, I realized that they had the tape in their recorder backwards and that it was regular American music. I'll bet they don't know it's backwards.

The extra day in Nepal cut my Calcutta stay to just one evening. More about that next month . . . and even more important . . . one of the most astounding countries of my entire trip: Burma. I am willing to bet that you don't have the slightest idea what is going on in Burma today . . . almost no one does . . . and it is virtually impossible for anyone to get into Burma to find out.

Contest Cheating

The contests are upon us and soon we will find our favorite bands awash with number swapping on weekends. Hundreds, sometimes thousands, participate to some extent in these marathons, but only a few dozen hard core psychopaths, bent on proving their superiority, make the serious effort necessary to win that most coveted of all awards: a teenyweeny printing of their call in an obscure column in QST or CQ.

Those of you who have entered past contests know that politeness and ethics sink into an abyss in the heat of the fray. Possibly you have entered a few contests and wondered why, when you worked so hard and seemingly did so well, that others came out way ahead of you?

The method of cheating depends upon the contest. The QST Sweepstakes contest not only invites cheating, but virtually demands it. This has been a laughing stock of ham radio for as many years as it has been around. In years gone by we would all read the list of winners, enjoying the fellows who ran 304TL's and claimed the low power multiplier. Their answer was simple, if they didn't claim the multiplier they wouldn't win. So we watched the yearly list of "winners" who, almost without exception, had to perjure themselves to get in the winning list. This is still going on and if you enter this contest you had better figure on lying if you want to win.

In all of the contests there is an arrangement whereby you can work multipliers. This can be ARRL sections, countries, etc. This is a natural area for creative cheating. The idea is to add in a few extra multiplier contacts to build up that final score a bit. Be shrewd about this padding, for the contest scorers are not completely unaware that this is a temptation. One system that has been proven not to work by one of our top DX'ers, is the leaving of blocks of contacts open in the log for later filling in. Our very well known friend was disqualified two years running for this stupidity. No, it is a lot better to leave an occasional open spot in your log as you go along. When you have a little break between contacts you can just leave a number open for later use. Then, when the contest is over, you can go back and fill in these blanks with the calls of stations that might have been on, but which were not active in the contest. Give vourself a low number from them, perhaps a two or three. You can easily add ten or so countries to your multiplier and it will be almost impossible to detect for the scorers. You have to know your stuff for this, for if you use the call of a station active in the contest it is too simple to check in the other log. And if you use the call of an inactive station the scorer might

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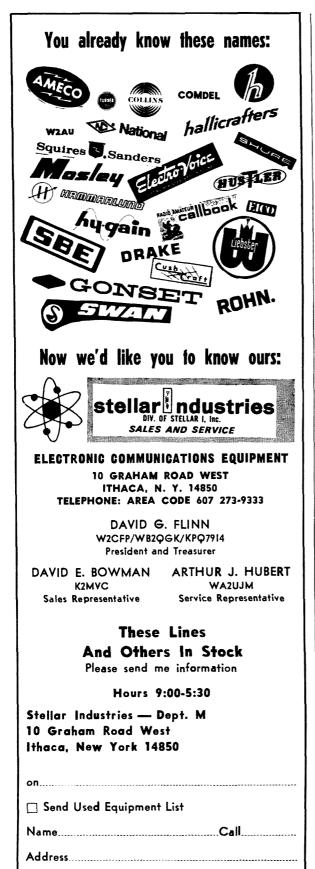
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just know this and the fat would be in the fire.

Perhaps it is time for us to take a good second look at the contests that are cluttering up our bands and decide whether they are worth the spectrum they take. The chaps running the contests are perfectly aware of the problems they have created and seem uninterested in doing anything to solve them. Until they can clean up their contests which demand cheating for a top score, shouldn't they spare us the weekends of chaos?

. . . Wayne

Push to Talk or Speak to Talk

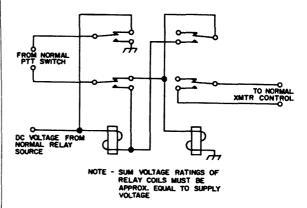
Controlling a transmitter is a common problem; push to talk is simple and effective, but it can be tiring if the QSO goes on for long. VOX is common, but it presents other problems as well; anti-VOX and background noise put the "bug" in this system.

Here's a simple idea to change from push to talk, and hold, to push once to talk and release, push again to stop transmitting. It may take a little getting used to, but once you're "on to it", it is simple and safe. It combines the sureness of push to talk with the convenience of VOX.

To operate, push your push-to-talk button once and the transmitter will stay on even when it's released. After your "speal", push again and your transmitter goes off.

If you're lucky, you may have two relays in your junk box; they can be any type as long as the voltage of both in series is under the supply voltage.

. . . David Collins VE3GLX



Relay arrangement used for switch-to-talk, speak-to-talk. Since no relay current is required in the off position, this circuit may be left in the standby condition with no relay power. The opposite is true in normal push-to-talk.

Technical Aid Group

The response to the Technical Aid Group was a little slow to start, but now the members are reporting that their mail is picking up momentum. Only one major problem seem to have cropped up: a manufacturer has asked one of our TAG members to design an electronic organ! This is *not* the reason that TAG was formed; it was formed as a ham-to-ham aid group helping hams with their technical problems, whether they are 73 readers or not.

If you have a question which can be answered adequately through the mail, look through the following list of TAG members, and write to one whose specialty covers your problem area. Be sure to write legibly and include a self-addressed stamped envelope with your request. TAG members are not obligated to answer queries which do not include a SASE.

If you feel you are qualified to help other hams and would like to join the Technical Aid Group, write for complete details. To do the most good, and to provide the best coverage, we need TAG members in all parts of the country.

Although 73 will help the Technical Aid Group with organizational help and publicity, we want it to be a ham-to-ham group helping anyone who needs help, whether they are 73 readers or not.

John Allen, K1FWF, high school student, 51 Pine Plain Road, Wellesley, Mass. 02181. HF and VHF antennas, VHF transmitters and converters, AM, SSB, product data, and surplus.

Bert Littlehale, WA1FXS, 47 Cranston Drive, Groton, Conn. 06340. Novice transmitters and receivers, AM, SSB, HF receivers, test equipment and homebrew projects gone wrong.

Bob Groh WA2CKY, BSEE, 123 Anthony Street, Rochester, New York 14619. Specializes in VHF/UHF solid-state power amplifiers, but will be glad to make comments on *any* subject.

Jim Ashe W2DXH, R.D. 1, Freeville, New York. Test equipment, general.

G. H. Krauss WA2GFP, BSEE, MSEE, 70-15 175 Street, Flushing, New York 11365. Will answer any questions, dc to microwave, state-of-the-art in all areas of communications circuit design, analysis and use. Offers help in TV, AM, SSB, novice transmitter

and receivers, VHF antennas and converters, receivers, semiconductors, test equipment, digital techniques and product data.

Don Nelson WB2EGZ, EE, 9 Greenridge Road, Ashland, New Jersey 08034. VHF antennas and converters, semiconductors, selection and application of vacuum tubes.

Stix Borok WB2PFY, high school student, 209-25 18 Avenue, Bayside, New York

11360. Novice help.

Clyde Washburn K2SZC, 1170 Genesee Street, Building 3, Rochester, New York 14611, TV, AM, SSB, receivers, VHF converters, semiconductors, test, general, product data.

Richard Tashner WB2TCC, high school student, 163-34 21 Road, Whitestone, New York 11357. General.

J. J. Marold WB2TZK, OI Division, USS Mansfield DD728, FPO San Francisco, California 96601. General.

Ira Kavaler, WA2ZIR, BSEE, 671 East 78 Street, Brooklyn, New York 11236. SSB transmitting, color TV, computer programming and systems, digital, radio and remote control, rf transmission lines, dipole design, audio amplifiers, linear and class C rf amplifiers

Fred Moore, W3WZU, broadcast engineer, 4357 Buckfield Terrace, Trevose, Pa. 19047. Novice transmitters and receivers, HF and VHF antennas, VHF converters, receivers, AM, SSB, semiconductors, mobile, test equipment, general, product data, pulse techniques, radio astronomy, bio-medical electronics.

Theodore Cohen W9VZL/3, BS, MS, PhD, 261 Congressional Lane, Apartment 407, Rockville, Maryland 20852. Amateur TV, both conventional and slow-scan.

Walter Simciak, W4HXP, BSEE, 1307 Baltimore Drive, Orlando, Florida 32810. AM, SSB, Novice transmitters and receivers, VHF converters, receivers, semiconductors, mobile, test equipment, general.

James Venable K4YZE, MS, LLB, LLM, 119 Yancey Drive, Marietta, Georgia. AM, SSB, novice gear, VHF, semiconductors, and test equipment.

J. Bradley K6HPR/4, BSEE, 3011 Fairmont Street, Falls Church, Virginia 22042

Wayne Malone W8JRC/4, BSEE, 3120 Alice Street, West Melbourne, Florida 32901, General.

Bruce Creighton WA5JVL, 8704 Belfast Street, New Orleans, Louisiana 70118. Novice help and general questions.

Douglas Jensen, W5OGJ/K4DAD, BA/BS, 706 Hwy 3 South, League City, Texas 77573. Digital techniques, digital and linear

IC's and their applications.

Louis Frenzel W5TOM, BAS, 4822 Woodmont, Houston, Texas 77045. Electronic keyers, digital electronics, IC's, commercial equipment and modifications, novice problems, filters and selectivity, audio.

George Daughters WB6AIG, BS, MS, 1613 Notre Dame Drive, Mountain View, California. Semiconductors, VHF converters, test

equipment, general.

Glen H. Chapin, W6GBL, 3701 Trieste Drive, Carlsbad, Calif. 92008. HF and VHF antennas, novice transmitters and receivers, VHF converters, semiconductors, receivers, AM, SSB, general, surplus.

Tom O'Hara W6ORG, 10253 East Nadine, Temple City, California 91780. ATV, VHF converters, semiconductors, general ques-

tions.

Steve Diamond WB6UOV, college student, Post Office Box 1684, Oakland, California 94604. Repeaters and problems regarding legality of control methods. Also TV, novice transmitters and receivers, VHF antennas and converters, receivers, semiconductors, and product data.

Orris Grefsheim WA6UYD, 1427 West Park, Lodi, California 95240. TV, HF antennas, SSB, VHF antennas and converters, receivers, semiconductors, and general ques-

tions.

Hugh Wells, W6WTU, BA, MA 1411 18th Street, Manhattan Beach, Calif. 90266. AM, FM, receivers, mobile test equipment, surplus, amateur repeaters, general.

Howard Krawetz WA6WUI, BS, 654 Barnsley Way, Sunnyvale, California 94087. HF

antennas, AM, general.

Carl Miller WA6ZHT, 621 St. Francis Drive, Petaluma, Calif. 94952. Double sideband.

Howard Pyle W7OE, 3434—74th Avenue, S.E., Mercer Island, Washington 98040. Novice help.

Ronald King K8OEY, Box 227, APO New York, New York 09240. AM, SSB, novice transmitters and receivers, HF receivers, RTTY, TV, test equipment, general.

Charlie Marnin W8WEM, 3112 Latimer Road, RFD 1, Rock Creek, Ohio 44084. General technical questions. Michael Wintzer DJ4GA/W8, MSEE, 718 Plum Street, Miamisburg, Ohio 45342. HF antennas, AM, SSB, novice gear, semiconductors.

Roger Taylor K9ALD, BSEE, 2811 West Williams, Champaign, Illinois 61820. Antennas, transistors, general.

Michael Burns Jr. K9KOI, 700 East Virginia Avenue, Peoria, Illinois 61603. AM, SSB, receivers, transmitters, digital techniques, novice help, general.

Jim Jindrick WA9QYC, 801 Florence Avenue, Racine, Wisconsin 53402. Novice

transmitters and receivers, general.

John Perhay WAØDGW/WAØRVE, RR #4, Owatonna, Minnesota 55060. AM, SSB, novice transmitters and receivers, HF receivers, VHF converters, semiconductors, mobile, product data, general. Has access to full specifications on almost all standard components presently catalogued by American manufacturers.

David D. Felt WAØEYE, television engineer, 4406 Center Street, Omaha, Nebraska 68105. Integrated circuits, transistors, SCR's, audio and rf amplifiers, test equipment, television, AM, SSB, digital techniques,

product data, surplus, general.

Tom Goez KØGFM, Hq Co USAAMAC, Avionics Division, APO New York, New York 09028. HF antennas, mobile, airborne communications equipment, particularly Collins and Bendix gear, AM, FM or SSB—HF, VHF, UHF, general.

Robert Scott, 3147 East Road, Grand Junction, Colorado 81501. Basic electronics, measurements.

PFC Grady Sexton Jr. RA11461755, WA1GTT/DL4, Helmstedt Spt. Detachment, APO New York 09742. Help with current military gear, information from government Technical Manuals.

PFC William A. Youdelman DL4FK/WA6LRS, DSMA B-4, c/o HHB, 6 Bn, 61 Aty, APO New York, New York 09225. Invites questions from members of US Forces in Europe regarding licensing or any technical questions they care to ask.

Eduardo Noguera M. HK1NL, EE, RE, Post Office Box Aereo 774, Barranquilla, Columbia, South America. Antennas, transmission lines, vast experience in tropical radio communications and maintenance, HF antennas, AM, transmitters and receivers, VHF antennas, test equipment and general amateur problems. Can answer questions in Spanish or English.



Knight-Kit KG-664 Regulated DC Supply



This new supply from Allied Radio is a versatile B+/filament/dc bias supply that fills the need for the multiple voltages required in circuit experimentation and troubleshooting. It is an excellent supply for the amateur since it delivers 0-400 Vdc (regulated) up to 200 mA continuous; 0-100 Vdc at 1 mA (regulated for line variations); plus 6.3 Vac at 6 amps and 12.6 Vac at 3 amps for filaments. The high-voltage output provides a capacity of 80 watts. The voltage and current of the dc supply is continuously monitored by two meters on the front panel.

The specially designed circuitry of the KG-664 permits less than one percent variation in output voltage from no load to full-rated load. Input regulation allows less than one percent variation for ± 10 volts variation at 120 Vac input. The advanced circuitry used in this supply is a hybrid design using both tubes and semiconductors for dependable long-term performance; output impedance is less than ten ohms.

Ten isolated five-way binding posts on the front panel offer maximum versatility in ground polarity connections. A heavy-duty operate/standby switch is included for maximum safety while making connection to the load. The KG-664 also features a rear chassis binding post for fast, easy grounding; a detachable ac line cord; and a well-ventilated metal case. Priced at \$94.50 in kit form or \$140.00 fully assembled. For more information, write to Allied Radio Corporation, 100 N. Western Avenue, Chicago, Illinois 60680.

Economical Motorola Zener Diodes

A new series of ½-watt Surmetic "20" zener diodes from Motorola cover a zener voltage span from 2.4 to 200 volts. The IN5221-81 devices, although rated at ½ watt with normal mounting conditions, have demonstrated excellent failure resistance when overstressed in 1-watt tests. All units have a 10-watt surge rating and devices above 14 volts have a leakage current typically less than 100 nanoamperes. or further information and data sheets, write to Technical Information Center, Motorola Semiconductor Products, Inc., Box 955, Phoenix, Arizona 85001.

New Callbook Feature

For the first time the United States edition of the Radio Amateur Callbook will include the license class identification of licensed radio amateurs listed. This new feature will appear in the form of the first letter of the individuals license class and will follow immediately after the call letters. Identification of the class code will be listed at the beginning of each district. This information will appear for the 48 states only; Alaska, Hawaii and U.S. Possessions will follow in a later issue.

Hallicrafters S-240 Receiver



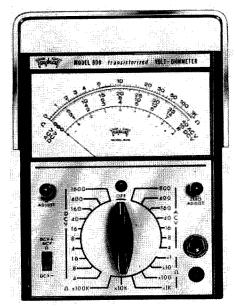
The new Hallicrafters S-240 is a low-cost, all-transistor receiver which doubles as an FM table radio. The standard communications-type features of the S-240 include an rf amplifier on FM for high sensitivity, selectivity and image rejection; a BFO for CW work; main and fine tuning controls for short-wave reception; an S-meter; a slide-rule dial; and automatic gain control circuitry. The S-240 covers the AM broadcast band, the 88 to 108 MHz FM band and the short-wave bands from 2 to 30 MHz. The short-wave bands are covered in three sections: 2 to 5 MHz, 4.5 to 11.5 MHz and 11 to 30 MHz.

The 11 transistor, 6 diode superheterodyne

circuit of the S-240 provides stable and drift-free operation as many tube-type receivers costing several times more. Sensitivity on FM is excellent and its 10.7 *if* bandwidth is 120 to 185 kHz. Combined with a +400 kHz AFC circuit, this selectivity makes FM tuning easy and constant readjustment unnecessary.

Priced at \$109.95, more information on the new S-240 is available from your dealer, or write to Hallicrafters Company, 5th and Kostner Avenues, Chicago, Illinois 60624.

Triplett Transistorized Volt-Ohmmeter

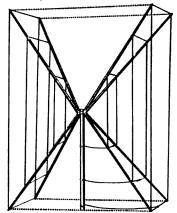


The Triplett Electrical Instrument Company has just introduced a new, lightweight transistorized volt-ohmmeter (TVO), the model 600, which has the portability of a VOM with the high input impedance (11 megohm) of a VTVM. It provides a frequency range from 15 Hz to 2 MHz and measures dc voltage, resistance and ac rms values with an accuracy of ±3% on both ac and dc at 77° F.

The Triplett model 600 is designed with a transistorized amplifier consisting of a special field effect transistor circuit to obtain an 11-megohm input impedance and improved stability over battery life and temperature changes. Typical battery life in the TVO is 4000 hours in normal use, which approximates shelf life.

The model 600 has an entirely new case design which uses a brushed aluminum front panel with etched black range markings. All meter controls are clearly marked on the aluminum panel, and the single selec-

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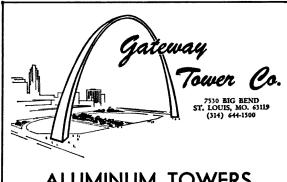
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The meter has been made easy to read by the addition of color to the various ranges and combining the ac and dc voltage readings. Other features of the model 600 include direct reading measurements for FM discriminator lineup, and a dc polarity reversing switch. \$78.00 from your dealer, or write to Triplett Electrical Instrument Company, Bluffton, Ohio 45817.

Personalized Door Mat



Amateurs who are looking for the unusual, and a new and interesting way to show their call letters might look into the new floor and door mat available from Herbert Salch & Company. These mats, 18 by 28 inches, are made of durable high-quality rubber with rubber fingers that automatically clean in a self-draining style. Available in black, brown, green and blue with your name and call in large white 2% inch letters across the middle. Limited to 13 letters. \$7.95, postpaid, from Herbert Salch and Company, Woodsboro MPR, Texas 78393.

Winco Alternators

Two new series of Winco power alternators for portable and standby electric power have been announced by Wincharger Corporation, a subsidiary of Zenith Ratio. The new heavy-duty alternators provide 2500 watts ac, 60 Hz, and operate at 1800 rpm. The only difference between the two series is the driving power-the 205BS uses a Briggs & Stratton engine, the 205WS, a Wisconsin engine. Both engines are of cast iron construction with Stellite valves and valve rotators for long life at 1800 rpm.

These heavy-duty Winco alternators will safely power a one-horsepower motor, plus a 400-watt resistive load and are ideal emergency power plants. They are available in manual, electric and remote start, in both single and dual voltages. Optional equipment includes a carrying handle, a carry-

New CZ - FS Series **Towers**

Write for Free catalog TODAY or see your distributor.

ing cradle, or two-wheel dolly mounting. Both series also permit a choice of fuels: gasoline, propane, or natural gas. For complete details and prices, write to Wincharger Corporation, 1805 Zenith Drive, Sioux City, Iowa 51102.

Jensen Electronic Tool Kit



A new, deluxe tool kit for electronic technicians has been introduced by Jensen Tools. This new 75-piece kit, designated the JTK-5, includes all of the tools normally required in building breadboards and prototypes of sophisticated electronic equipment.

The inclusion of basic metal-working tools in the kit permits the experimenter to construct a wide variety of electronic assemblies requiring panel and chassis work. Each kit includes files, a scribe, precision knife, wire bending pliers, diagonal cutters, slip-joint pliers, scissors, screwdrivers, slide caliper, soldering iron and solder, soldering aids, tweezers, wire stripper, adjustable wrench, hex and spine-key wrench sets, %-inch electric drill, drill case with drills, chassis punches, ball pein hammer, center punch, hacksaw, taps, reamer and electronic alignment tools. "The kit comes complete with a steel toolbox and tray. A catalog describing this tool kit may be obtained by writing to Jensen Tools, 3630 E. Indian School Road, Phoenix. Arizona 85018.

Maestro Receiver Booster

If you're looking for a way of increasing the sensitivity of your receiver on ten meters, the new Maestro Booster from Wawasee Electronics may be just what you're looking for. This unit, although designed for CB equipment, performs nicely in the 28 MHz amateur band. It requires no wiring into the receiver, has a built-in antenna switching relay and requires no tuning or adjustments. The use of a 7788 vacuum tube with 10,000 hours life (equivalent to five years operation) results in 3 to 5 S-units of receiver boost. \$64.50 from Wawasee Electronics Company, Post Office box 36, Syracuse, Indiana 46567.



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Electronic Engineering Measurements Filebook

Although many of the measuring techniques covered in this new book from TAB Books are not particularly adaptable to the amateur workshop, they are very useful to the amateur who is a technician or engineer in industry. Many of the "measurements" texts cover only the generalities of various tests and measurements, but the "Electronic Engineering Measurements Filebook" is a collection of detailed techniques, complete with specific test setups, waveforms, and analysis of how to measure specific parameters.

Each of the techniques described includes data on the test equipment and/or circuitry required, test procedure, interpretation of the results and special considerations and pitfalls, if any. The most interesting feature of this book is that the techniques it describes covers measurements that cannot be made using the usual procedures. Items that are especially useful to the amateur include measuring noise with a VTVM, measuring fr of a transistor, measuring transistor smallsignal hybrid parameters, measuring transistor hre at 100 MHz, measuring Y-parameters of field effect transistors, and how to select the right probe. In most instances the techniques described can be readily modified and adapted to suit the reader's specific needs, \$9.95 from TAB Books, Drawer D, 18 Frederick Road, Thurmont, Maryland 21788.

James Millen Catalog

The James Millen Company's new components catalog lists all kinds of goodies for the ham. A complete line is available, including tube sockets, flexible couplings, plate caps, safety terminals, terminal strips, dial locks, miniature inductors, rf chokes, airwound transmitting inductors, transmitting and tuning capacitors and many other items. There is also a set of miniature components, plus high-voltage rf switches, panel dials and if transformers. In addition to the components listed in this catalog, James Millen manufactures grid dip meters, amateur radio equipment, module oscilloscopes, magnetic shields and delay lines. For your personal copy of their new components catalog, write to James Millen Company, 150 Exchange Street, Malden, Massachusetts.

Selected Electronic Circuitry

If you're looking for a novel circuit to do a special job, NASA's "Selected Electronic Circuitry" may have it. This new book from the Government Printing Office has chapters on amplifiers, oscillators, multivibrators, power supplies and related circuits, wave shaping circuits, temperature compensation circuits, control circuits and computer circuits, plus a glossary of terms. In selecting the circuits for this book. NASA made an effort to include novel circuitry that is of interest not only to the professional engineer, but to the electronics hobbyist as well. If you can't use any of the 78 circuits directly, they will give you some interesting ideas. A must at 70¢ from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Order NASA SP-5046.

Solid-State Power Control Circuits Library

A new applications oriented, power control circuits guide compiled from a series of application notes written by Motorola semiconductor engineers is now available. "Solid-State Power Control Circuit Library" presents new and useful solutions to many common thyristor control problems. Topics included in this 70-page book are SCR power control fundamentals, trigger circuits, suppressing rf interference, high torque motor speed control and reducing SCR failures. Free copies of this handy new book may be obtained by writing on your company letterhead to Motorola Semiconductors Products, P. O. Box 995, Phoenix, Arizona 85001.

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Letters

CB'ers, Novices, and all that Jazz Dear 73.

A short, though pointed, dissertation upon your July editorial, if I may.

First, although I try to keep abreast of developments in hamdom, and regularly purchase most of the magazines in the field, I am not myself an amateur. This is not due to lack of ability-I could pass the test tomorrow with no difficulty. My choice was based upon a lot of consideration and thought.

. . It is my own personal observation that the Citizen's band has done more to afford hamdom new members than you realize . . . I can point out a dozen in my area who have forsaken CB for the ham bands, if for no other reason than to be able to talk without incessant "break-break" from some loud-mouthed moron whose brains are wired to switch off when he hits the mike button.

Granted, initially, CB holds a sort of appeal to a newcomer to radio . . . plunk down \$8, shell out a few more bills for a full-house peanut-power transceiver, and presto-instant radio. For a while it is the greatest thing since puberty. However as time progresses, and one gets to know the type of clewns who share these bands, he gets an itching to go somewhere where the people are a shade more sane, and considerably more intelligent.

I think it is well to look elsewhere for the source of the apathy which is running amateur radio down the ramp behind the dinosaurs and the dodos.

I would offer this possibility. That ham radio has simply lost all it's glamour, as I believe you pointed out. There was a day when to be a ham, one spent long hours burning the midnight lights, sweating over a hot soldering iron, cussing an occasional scorched thumb, and laboriously piecing together a home-brew monster that, with a healthy dose of miracle working, might possibly work.

Today the ham is a new breed. He memorizes the code, bones up on the theory, and lays out a wad of the long green for a room full of prewired, pretested, guaranteed-to-work-or-your-money-back, appliances with their aesthetic chromium baubles and

Frankly, ham radio has been overwhelmed by science. I do believe that, as you noted, more good PR will alleviate this apathy somewhat, and the news of a ham rig on the moon will draw a lot of fence riders into the pasture. Howevermuch, we have another question . . . why does hamdom need more hams?

Evidently, there are too many hams on the air already, without adding to the confusion. You may well point out the huge silence which envelopes the VHF bands, and I fully agree. But it is one thing to promote them and quite another to get John Q. Ham to go up there and clear out the lower bands. VHF is the playground of the elite amateur who is well up on his theory and who can do more than twiddle knobs

So there the situation stands—a few hearty souls up on the high end and all the other 99.5% crammed like sardines into 80 thru 10, fighting tooth and nail for a few unmolested kHz on which to carry a QSO.

What we need is not more amateurs, but more HAMS of the old school who don't rely on their wallet, and who aren't afraid to try something new and different.

This is one major reason I am avoiding becoming a ham myself. There is no one around here on VHF and I'll be damned if I'm going to get into that ratrace on the dc bands. I'm going to just stand back and watch, as hamdom strangles itself to death, because nobody has the brains to get out and go up, and the low bands will gradually turn into mass confusion.

As I see it now, more amateurs will kill ham radio, rather than cure it.

If you can present a convincing enough case, I'll go for the ticket and join the hysteria. I don't suppose that one more carrier will matter that much . . . will it?

> Bob Renaud Washington, Mass. 20123

Now if we could get a few more hardy souls to try 432 and 1296 in northern New England . . .

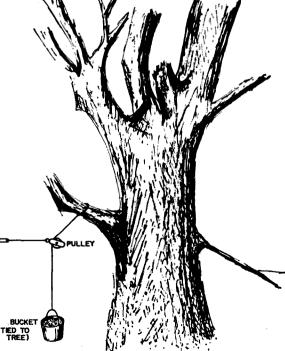
OOPS . . .

Dear 73.

RE: Judy's Antenna p. 103, July issue.

Poor Joe is going to get killed or hurt if that antenna breaks! Please have Judy re-install her new antenna with the bucket of sand tied securely to the tree and the pulley tied to the antenna, as shown in the sketch below. You don't believe it? It happened to me once, only my bucket was filled with concrete. Fortunately, no one was under it at the time, but the hole in the ground gave pause for a lot of thought.

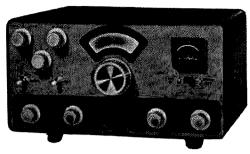
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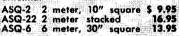
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Dear 73.

I disagree with W1DTY's editorial (August 73). Permitting phone operation on ten meters would certainly make the Novice license more attractive to the non-ham (and CB'er). But, it would reduce the motivation a Novice has to operate CW, and thereby increase his CW proficiency to 13 WPM. Extending the term of the license to two or more years would probably help very little. Many Novices would spend their first year or so CB'ing it up on ten phone, forgetting what little CW they had to learn to pass the 5 WPM novice test.

As for the argument that the proposal would allow the Novice to "see what amateur radio is really like", I suggest that the Novice use his receiver for this purpose. If he finds HF phone operation appealing, well, that's another reason to hurry up and get his General. Anyway, I doubt that a 200 kHz segment of ten meters, far from the General-class action, would be much of an education. The Novices would only have each other to talk to, and they might pick up some bad habits from the ex-CB'ers amongst them.

One more gripe: Wayne's ideas about Vietnam, be they good or bad, do not belong in 73. He should know that.

Vic Rosenthal K2VCO/3 Pittsburgh, Pa.

Dear 73.

I am very much disturbed with the idea of the FCC granting possibly "A Radical Proposal" to the would-be amateurs, "CB's". I feel that I am in a position to express my truthful opinion, because I once held the call 1W9296, and therefore would be classed an "OM" on the Citizens Band.

I feel that obtaining an amateur ticket is an accomplishment in it's self, due to the fact that you can not simply fill in an application and expect to receive a call sign. You must do some work on your own. The only persons who want this proposal are the typical "C.B. Lids". Why should we give them some of our frequencies to use improper operating procedure on, etc. Let them study and obtain their licenses like all of us had to. We amateurs would be more than happy to help them out to get on the air, I'm sure. But, not by changing the license exam.

I'm sure that once you obtained your license, you had the feeling of a job well done, so let's keep our proud name and by all means let's keep the amateur code and theory exam.

Grady L. Sexton, Jr. WA1GTT/DLØ Berlin Brigade APO 09742

Oops, wrong magazine Grady. I think the radical article was in CQ!

More AM/SSB

Dear 73,

Congratulations on your article in June 73 concerning AM vs SSB. In this day of crowded frequencies, should we tolerate a mode of transmission that uses twice the band width necessary for communications? . . . I would like to suggest no AM operation in the 3.5, 7, and 14 MHz bands. In the 21 MHz band, no AM above 21.300 MHz, and in the 28 MHz band, no AM below 29.000 MHz.

Henry R. Pemherton W3PN Wayne, Pa. 19087

Dear 73,

... Overall, 73 is great—but with one horrible deficiency: you are bowing to Big Buddha QST's lordly dictum that there is no such thing as AM phone.

Why ignore a significant group of amateurs who thoroughly abhor the crude methods by which SSB is being jammed down their throats?

John M. Murray W1BNN Bloomfield, Conn.

Dear 73.

Recently there has been much controversy about the use of AM on the 20-meter band. Amateurs using AM claim that their right to operate in the "AM" portion of the band was established in a long-standing gentlemen's agreement. It is just coincidental that this AM portion is the segment of the band in which the majority of DX work is done.

... I operate Sideband and I am not what one would call a "big gun" and thus, my voice is not well known on the air. However ... it becomes particularly annoying to me when the local AM'er comes on and hetrodynes the station I am talking to out of existence.

I am not condemning AM as a mode . . . I am suggesting that a new Gentleman's Agreement be made, in which AM operation be confined to a different segment of the phone band. 14250-14300 kHz seems to be the likely choice. This allows ample room for operating and leaves the lower 50 kHz of the phone band free for serious DX work.

D. Christopher Ohly WB2YOA Brooklyn, N.Y.

Dear 73.

... In banning AM you are essentially banning the new builder. In taking the steps from Novice to General, a builder type must stop at AM to learn what ien't in the license manual or beginner's radio books... AM equipment is relatively easy for the beginner to make.

I am not sure whether your remarks on the ease with which DSB can be built is correct or not. There is no up-to-date literature on it that I can find. Articles refer either to a 1953 73 or a 1647 QST issue. They're not easy to find.

Charles L. Hyser WA3GXM Strafford,—Wayne, Pa.

Try July 1967 issue of 73, page 10.

Dear 73.

Yes! I am thru with 73 magazine for a very good reason and it is your own fault. When you decided ham radio was only for Slop Bucket and not for AM you let me out. Your last editorial (June) tore it for me. I am recommending by letter and by air that my hundreds of friends also send the five bucks to hAM International instead of renewing 73. So, get ur subs from the SB boys.

P. F. Hadlock K2IK Hammond, New York

I'll bet you said just about the same thing when they made you get off spark.

Bouquets and such

Dear 73,

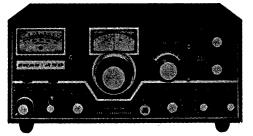
Just finished the July issue of 73 and I must say you have paid a wonderful tribute to our Canadian neighbors. The article about the Maritime Mobile stations was excellent.

I agree with the editor's views wholeheartedly. CB has had an unfortunate influence on young people. It is too easy to get a license in the first place, and, in too many cases the adults using the band do not set a good example.

Also wanted to congratulate you on the series on getting a Novice license . . . it will surely be of great help to many.

Anne Lefler WA1ELV Mansfield, Mass.

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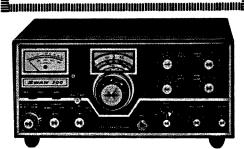
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Dear 73,

Congratulations on your new Editor. He is doing a fine job, and has rekindled in me a new enthusiasm for your remarkable magazine.

I am also pleased to see a more humble and more constructive W2NSD/1. His new attitude of working to improve ARRL operations, rather than destroy them, makes sense. And in his disillusionment with DX Expeditions, I even detect a relenting attitude on the desirability of QRP operation. QRP operation will improve the state of the art. The argument that more people should use high power to demonstrate the presence of radio amateurs on the bands is absurd, as ten minutes of listening to them will verify.

Now just a word about the letters in your May, 1967 issue. For further information about anti-gravity projects, WA6DZL might contact WØNL, who publishes Auto-Call. I should like to disagree with WA9OHS, because I find the new binding of 73 is excellent, and the magazine stays open just fine if you crease it at the margin. My one argument with your format is the practice of distributing advertisements throughout the magazine. This makes it impossible to tear them out to reduce the volume on the bookshelf. The problem is that too many of your articles are worth saving.

Thanks for not splitting up articles in bits continued at the back of the magazine. It makes them easier to file separately for reference material. The main problem comes when two good articles on different subjects come together. Could you please alternate good articles with irrelevant filler? Hi.

R. L. Gunther VK7RG Sandy Bay, Tasmania, Australia

Dear 73,

The excellent manner in which you handled the W2USA story is deeply appreciated by me! Yesterday there were two regular "on-the-air" meetings of Florida groups. Some very complimentary things were said. Many nice things were said about your editorial, with nary a word counter.

Arthur H. Lynch W4DKJ Fort Myers, Florida

Dear 73.

Will you please send me a copy of the marvelous editorial written by you in the July 73. I think it is perfect. It puts the case on the table. I want to reproduce it and give it to our club members. Keep up the good work Jim Fisk W1DTY.

Eugene W. Sickles WA5DMT Fort Smith, Arkansas

Dear 73.

The August issue of 73 arrived yesterday . . . getting bigger and better every month. Congratulations.

I read your editorial as soon as I opened the mag. (I always do). On page 2, you made the strtement, 'even the best five band transceiver does not cover the entire 28 MHz band!' Now, Jim, I realize that my Swan 500 is one of the best, and I have been under the impression that I could work the entire 10 meter band. I hope the FCC knows about those bootleggers I have been talking to up there, hi.

We were under the impression that one of the proposals the FCC acted upon last year was to disallow the same "two year for novices" that you spoke about. Personally I am all for it.

> Bill Moss WA8AXF Petoakey, Mich.

Sorry about that!

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Dear 73.

No Sir! Don't stop my magazine, gotta have it every month.

I've been wanting to write you about 73. It's a real good educational, helpful, and inspiring magazine. Beats all the others to heck. Those transistors look simple, the way they are connected. Other magazines show complicated hook-ups. I've been a "tube man" for 20 years, but not anymore . . . keep up the good work.

> Leroy Lawmaster W5HOM Watts, Oklahoma

Dear 73,

This is a brief letter of thanks. It is good to have an alternative to ARRL's Messiah complex and CQ's ho-hum attitudes. Please stay as refreshing and vital as you are now.

It takes daring for a special interest group publication to devote almost an entire number to a single topic, such as your treatment of Quads in May; however, I predict that issue will be nearly a reference work on all the aspects of them.

. . . The way to keep ham radio progressive, and to insure it a place in the spectrum in days ahead is not to bewail how backward we all are in editorials, and then devote the remainder of an issue to 75-meter sideband, as QST does each month. The way any ham magazine can help keep ham radio up to the "state of the art" is to do what you are doing. Publish thought articles as well as nut and bolt descriptions. In line with all this, I will volunteer for the Technical Aid Group.

> William J. Barrett K1VVQ Old Greenwich, Conn.

Dear 73.

Regarding July 73, p. 33, is a display of QSL cards received by W2USA at the 1939 World's Fair. You said it would be interesting to know if anyone had a duplicate of any of the cards. Third row from right, seventh card down is W8SCW. My card is dated 3-8-'39. Also, ninth row from left, 8th card down is W8SKQ. My card is dated November 14, 1938 and is for a 40 meter CW QSO. I also have another duplicate of this card dated 1-31-61 for a 40 meter phone QSO. How about that. 22 years apart and we exchanged same old QSL cards.

Would be interested in seeing more articles about the good old days.

> Louis Pastor W8SLF Barberton, Ohio

Look for the article on pioneer DX in this issue.

Dear 73.

I read with interest in July issue of 73 letters "The Fabulous Drone" by Mr. Nick Basura of Los Angeles, Cal., so I'll ask him to move over as he has more company. I thought to be alone in these thoughts and was afraid to express them. When Thomas Edison's birthday comes, the local radio station gives him quite a build up and credits him with just about everything in electricity. Did you know that Nikola Testa discovered ac current? Dumping the generator, transformer and motor on George Westinghouse's desk for which he received \$1 million . . . He died in New York in 1934 with 8¢ in his pocket! What happened to the million dollars? He put most of it into his experiments. Were he a business man, the flyback in TV receivers would carry his name. Thomas Edison was a business man, while Nikola Testa was an inventor. In hopes Testa receives some credit on his birthday . . .

> Joseph E. Vucco W8HCL Warren, Ohio



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FM

Dear 73.

FM amateur activity is growing exponentially in the U.S. in spite of the tendency of ham magazines to pretend it doesn't exist.

How much longer are the major journals going to ignore FM as a standard mode of communication for amateur radio operators? . . . Today, there are thousands (and this is no exaggeration) of active amateurs operating on deeply entrenched FM channels on two and six meters across the country.

I speak for us all, I'm sure, when I say that we'd like to see some promoting of our favorite mode of operation in the major amateur magazines. We would all like to see a monthly column devoted to FM operation.

. . . Even Electronics Illustrated carried a full-length feature article (July 67) about FM activity on two and six meters. FM activity is now so universally accepted that one can read about it almost anywhere.

Anywhere, that is, except in the ham journals,

Ken W. Sessions, Jr. K6MVH Ontario, California

Radio Parts to India

Dear 73:

I am taking the liberty of enclosing a copy of a letter I have received from Girish VU2HGZ, which I thought might be of interest to you.

. . . I have become convinced that if we wait for the ARRL or any other organization to do something to help advance amateur radio in India, it may be too late in many instances to take advantage of the opportunity which exists.

I wish there was some way in which parts and simple equipment could be sent to those fellows who are in such great need of it. It hurts to have Girish ask for low-power transmitting tubes, GDO's, components, etc. which U.S. amateurs have lying around their shacks.

> Morgan W. Godwin W4WFL/WA2WOR New York, New York

Excerpts from VU2HGZ's letter follow:

My Dear Morgan Godwin,

It was with the greatest pleasure that I received your letter. I was very pleased to read the 73 editorial regarding hams in India and other developing countries in the world. He is quite right in suggesting that we do not need very sophisticated equipment . . . what we need is a lot of technical literature and also lots of components in reasonably usable condition.

. . . I am Secretary of the Gujarat Amateur Radio Society. Today we have about 20 licensed members in the club, with about 30 more coming up. But we have totally run out of parts and so are in the doldrums.

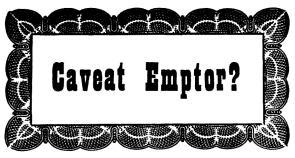
... Some of the members of the club are VU2MQ, VU2MVZ, VU2CC, VU2PWZ, VU2PXZ, VU2RE, and VU2HD. Small gifts sent individually, and in small packets, can be received by us with no formality. We also need some valves (6146), etc., phase shift networks, grid dip meters, and cathode

ray tubes, etc.

The club meets thrice a week in a small shack with VU2GC as a club station where we also take regular free Morse Code classes and guide everybody.

Girish H. Shah VU2HGZ Maternity and Nursing Home Relief Road Ahmedabad, India

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- ★ We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.
- ★ For \$1 extra we can maintain a reply box for you.
- ★ We cannot check into each advertiser, so Caveat Emptor . . .

CHRISTIAN HAM FELLOWSHIP now being organized for Christian fellowship and for gospel tract efforts among hams. Christian Ham Callbook for \$1 donation. Free details on request. Retired ham to run missionary net desired. Christian Ham Fellowship, Box 218, Holland, Michigan 49424.

WANTED: January and March, 1961, issues of 73 Magazine for my personal collection. S. B. Young, WØCO, Rural Route 3, Box 94, Wayzata, Minnnesota 55391.

TELEVISION CAMERAS: 2 RCA TH-10 heads with I.O.'s, video DA's, Processors, Color monitor TM 10, TM 21. Make offer, or inquiry. Harold L. Harrington, 908 W. Beaver Ave., State College, Penna. 16801.

SWAN 350, one month new, in mint condition, \$360; Swan 14-117 AC/DC Power Supply, with cables, \$75, or both units for \$420. 18AVQ antenna for \$25. All FOB Los Angeles. Selling out. Send certified check or money order to Alan Snowden, K6YPB, 22740 Clarendon St., Woodland Hills, Calif. 91364.

CANADIANS: EICO 753 transceiver, 751 P/S, one year old, \$375. McCoy 48B1 9-Mc xtal filter unused, \$35. VE2DDH, Box 1116, Senneterre, PQ.

TRADE COMPLETE Collins Station, factory reconditioned 1967: 75S-1, 32S-1, 312B4, 516F2, 30L-1 for late model pick-up truck with camper. Bob Pettyes, 6728 Newman, Arvada, Colorado.

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FOR SALE: Drake 2B Receiver and 2BQ multiplier. Mint condition. \$195.00. Pick-up only. WB2CTQ, 210 Roosevelt Ave., Oakhurst N.J. 07755. Phone 201-531-0246.

GALAXY V, AC SUPPLY, speaker console and Turner mike. Used less than 8 hours. \$300. WA5GGF, 1601 Everglades, Tyler, Texas 75701. CHARGE IT at Edwards Electronics. Discount prices with time payments. New Equipment, full warranty. Drake TR-4 \$511, R-4A \$349.50, T-4X \$349.50, Galaxy V Mk II \$365, SW-350 \$365, SW500 \$430, SB-34 \$360. Payments as low as \$10 monthly. We take trades: Reconditioned specials: NCX-3 \$199, SW-240 \$189, SB-34 \$279, SW-350 \$299, Galaxy V \$299, HT-37 \$199, HT-32 \$199, 2-B \$199, 75S-1 \$275, 75A-4 \$425, Viking 500 \$199, NC-303 with 6&2 converters \$239. Send for big list. Complete selection of Drake, Galaxy, Swan, SBE, HyGain, NewTronics. New Ham-M rotator \$99.95, Edwards Electronics, 1320 19th St., Lubbock, Texas 79401. Phone 806-762-8759.

HOMEBREW LINEAR with 4 811-A's, TR switch, filter and nine 811-A's, for \$75. Ship collect. Dave Gould, 5600 Sly Park Rd., Pollock Pines, Calif. 95726

DX-100 \$80.00; SX-140 \$70.00. Both mint. Unused GD-125 Q-mult, \$10.00. All for \$150, or make offer. FOB. WAØNDV, 611 N. Hartup, McPherson, Kansas 67460.

Swan 350 and matching 117-C power supply. Excellent condition. Also Turner 454X SSB Microphone, SWR meter, CDR TR-44 rotor, Bud lowpass filter. \$400 for complete package or make offer on any or all of above items. Robert Woerner, WA8NSJ, 14662 Lakeshore Drive, Grand Haven, Michigan 49417.

SACRIFICE FOR QUICK SALE Swan 240, mint condition, used only 4 hours, original carton. \$150. WA4WAO, 1815 Forney Drive NW, Huntsville, Ala. 35805.

MARYLAND 2-METER TERMITE NET CONTEST begins 2100 GMT October 21, runs 24 hours. For contest rules, etc., write the club at Box 153, Linthicum Heights, Maryland 21090.

MILITARY SURPLUS TV EQUIPMENT, by Roy Pafenberg, giving schematics of CRV-59AAE TV Camera, CRV-59AAG high sensitivity camera, CRV-52ABW TV transmitter, CRV-60ABK TV monitor unit, and CRV-46ACD TV receiver, all for \$1.00 from 73 Magazine, Peterborough, N.H. 03458.

FOR A COPY OF the Weidner radio news letter, write A. T. Cline, Jr., 240 Peachtree St., Atlanta, Ga. 30303.

EXCELLENT SUPERPRO (BC779) tuner and IF cans on aluminum chassis with panel, hardware, schematics. Make offer. J. Sandberg, K6YPU, 1138 Rustic Rd., Escondido, Calif. 92025

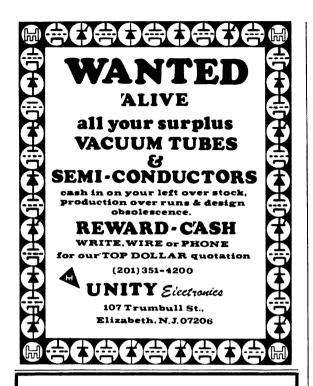
QST 1931-1942 bound, good condition. Make offer. David Garland, Swarthmore College, Swarthmore, Pa. 19081.

SELLING CESSNA 170 airplane. Will take Collins S-line or KWM-2 in trade. Also need kilowatt slim profile linear. KØTGR, Paul DuBois, Route 5, Newton, Kansas 67114.

ETCHED CIRCUIT PROJECTS from 73. Send your name, address and 4ϕ stamp for a catalog of etched circuit boars, to Harris Company, 56 E. Main St., Torrington, Conn. 06790.

RANGER 11, \$225.00. NC-270, \$100.00. Clegg 22'er with mike. \$200.00. Want 2-meter FM. James Kelley, K4YBB, 942 NW 16th St., Miami, Fla. 33168.

HEATH SENECA 6 and 2 meter transmitter. Mint condition. \$150. R. Stephens, W2NTZ, 3048 Wilson Ave., Bronx, N.Y. 10469.



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ALLTRONICS-HOWARD CO. Box 19, Boston, Mass. 02101. Tel. 617-748-0048 WANTED: Used radio and electronic textbooks. Anything from before 1900 to present day. I will buy any copies that I do not already have in my personal collection. Please state title, author, date, price and condition. W1DTY, RR 1, Box 138. Rindge, N.H. 03461.

SELL: Pair of slightly used 8122's. \$10 each. S. Roth, W2FXO, 12 Long Hill Dr., Clifton, N.J.

SP600JX1F with manual. No modifications. Excellent condition. Sell or trade for linear amplifier. Will shop FOB. KL7OK/KH6, Box 291, Wahiawa, Hawaii 96786.

\$1 BRINGS construction data for the new and unique Barb'd Wire Antenna. An easy, low-cost application of the fat-dipole theory. C. Leroy Kerr, Box 444, Montebello, California 90640.

WANTED USED as is GE TPL 150 Mc mobile units. W5PAX, 509 E. 41st., Austin, Texas 78751.

MUST SELL Apache SB-10 and HQ-145XC with xtal cal. for \$300. Will add Heathkit HO-13 Ham Scan to deal. WA9KQG, 1003 7th St., Hudson, Wisconsin 54016.

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CLEGG INTERCEPTER B with Clegg All Bander in good condition. Price firm \$250.00 for both FOB Stanhope, N.J. Glenn C. Ward, WA2KZF, RFD 1, Stanhope, N.J.

SB-100 WITH MATCHING HP-23 AC/PS, HM-15 SWR and SB-600 speaker. Mint condition, \$400.00. Vito Fiore, K9UCM, phone 312-749-0913.

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THE NEW MAINLINER TT/L-2 appears in September RTTY Journal. Do you subscribe? \$3 per year in U.S. & Canada. P.O. Box 837, Royal Oak. Mich. 48073.

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MUST SELL HT-37 and NC-300 both for \$375. I want to buy an SB-100. WAØMYH, 240 Sunrise Dr., Huron, S.D. 57350, phone 605-352-9582.

CONAR 500 RECEIVER. IDEAL FOR NOVICE STATIONS, \$33. Ameco CB-2 converter, 7-11 mc output, \$20. Both items postpaid. William Weir, WB4GEW, 406 Prospect, Berea, Ky. 40403

WANTED ARC-5 R-19 receiver in good condition. Also need TR-44 or heavy duty TV rotator. William Weir, WB4GEW, 406 Prospect, Berea, Ky. 40403

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HQ-129X less cabinet for rack mounting \$40 plus shipping. DX-100 \$75 plus shipping. Astatic microphone 888 for broadcast station \$40. Roache, Canterbury, Conn.

HALLICRAFTERS HT-37 \$175. SX-101A \$175. SX-99 \$75. Skyrider Defiant \$25. RCA Voltohmist VT-VM \$15. Simpson 260 VOM \$15. Excellent condition. WØKON/7, Box 473, Sumner, Wash.

COMPLETE 6&2 METER STATION. TX-62 VFO HE-80, CN-144/PS1, Dow Relay, 729sr mike. Excellent, \$250. Heath Two'er like new \$40. WB2OMK Wyoming, N.Y. 14591.

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MOTOROLA new miniature seven tube 455 kc if amplifier discriminator with circuit diagram. Complete at \$2.50 each plus postage 50¢ each unit. R and R Electronics, 1953 South Yellowsprings, Springfield, Ohio.

TOROIDS-DIODES-COAX-CONNECTORS. mH toroids-45¢ each, 5/\$2.00. 1000 PIV 1 Amp Top-Hat Diodes—55¢ ea, 2/\$1.00. Connectors, PL259, SO-239, M359—45¢ ea, 10/\$4.00. Button feed-throughs (while they last) 500 pF @ 500 V. 20/\$1.00. Add sufficient postage. R & R ELECTERONICS. TRONICS, 1953 S. Yellowspring Street, Springfield, Ohio.

VARIACS—General Radio and Ohmite. 60 cycles, Input 120V—output 0-280 V. 1 amp or input 240 V -output 0-280 V. 2 amp. PULLOUTS IN GUAR-ANTEED EXCELLENT CONDITION \$6.95 plus postage. Shipping weight 10 lb. R & R ELECTRONICS, 1953 S. Yellowspring Street, Springfield, Ohio.

WANTED: Volume 1. Number 1 of VHFER magazine to complete my collection. W1DTY, RR1, Box 138, Rindge, N.H. 03461.

REED RELAYS SPST-N.O. Coil rating: 2.9 volts at 12 ma. Contacts rated for 12 VA; max. 300 volts or 0.50 amp. Sample usage circuits included. Body size 1" x ½". New low price \$2.35 plus 25¢ handling and postage. Airstar Products, P. O. Box 323, Marion, Iowa.

GREATER BAY AREA HAMFEST will be held again this year at the Edgewater Inn, Oakland, California, on October 14 and 15, 1967. For full information write to Greater Bay Area Hamfest, P. O. Box 545, Hayward, California 94543.

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EASTERN UNITED STATES TO:

14 21 ALASKA 7A 7 74 21 ARGENTINA 14 14 7 7 14 21A 21A 28 28 21 14 AUSTRALIA 21 14 14 7B 7B 7B 7B 14 14 14 21 25 CANAL ZONE 14 14 14 14 7 7 21 21 28 28 28 ENGLAND 7A 7 7 7 7 14 21 21 21A 21 21 HAWAH 21 14 14 7B 7 7 7 7B 14 21 21A INDIA 7B 7B 7B 7B 7B 14 21A 21 14 14 JAPAN 14 14 78 7B 7B 7 7 7 7B 7B MEXICO 21 14 14 7 7 7 14 21 21 21 PHILIPPINES 14 14 7B 7B 7B 7B 7B 7B 14 14 14 7B 14 PUERTO RICO 14 14 7A 7 7 7 14 21 21 21 21A SOUTH AFRICA 14 14 14 7A 78 14 21 28 28 28 21A 21 U. S. S. R. 7 7 7 7B 14 21 WEST COAST

CENTRAL UNITED STATES TO

ALASKA	21	14	14	7	7	7	7	7	14	21	21	21
ARGENTINA	21	14	14	14	7	7	14	21A	21A	28	28	28
AUSTRALIA	28	21	14	14	14	14	7B	14	14	14	21	28
CANAL ZONE	21	14	14	14	7	7	14	21	28	28	28	28
ENGLAND	7A	7	7	7	7	7B	14	21	21 A	21	34	14
HAWAII	21.A	21	14	14	7	7	7	7B	14	21A	28	28
INDIA	7	7B	78	78	78	7B	7B	14	14A	14	14	7
JAPAN	21	14	7B	78	7B	7	7	7	7	7B	14	21
MEXICO	14	7	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	14	7B	713	7B	7B	7	14	14	14	7B	14A
PUERTO RICO	14	14	14	14	7	7	14	21	21	21 A	21A	21
SOUTH AFRICA	14	14	14	7A	78	14	21	21	21 A	38	28	21
U. S. S. R.	7	7	7	7	7	7B	14	21	21	14	14	14

WESTERN UNITED STATES TO:

ALASKA	21	21	14	7	7	7	7	7	14	21	21	21
ARGENTINA	28	21	14	14	14	7	7	21.A	21A	28	28	28
AUSTRALIA	28	28	21	14	14	14	14	7B	14	14	21	28
CANAL ZONE	21	14	14	14	7	7	7	21	28	28	28	28
ENGLAND	7A	7B	7	7	7	7B	7B	14	21	21	н	14
HAWAII	28	28	2 IA	14	14	14	14	7	14	21A	28	26
INDIA	14	21	14	78	713	7B	78	7B	14	14	14	78
JAPAN	21A	21	14	14	78	7	7	7	7	713	14	21A
MEXICO	21	14	7	7	7	7	7	14	21	21	21	2 M
PHILIPPINES	21A	2 IA	21	14	7B	78	7	7	14	14	7B	14A
PUERTO RICO	21	14	14	14	14	7	7	14A	21 A	28	28	28
SOUTH AFRICA	21	14	14	7B	7B	7B	14	21	21	21A	21A	21
U, S. S. R.	7B	7B	7	7	7	7B	7B	14	14	14	14	14
EAST COAST	21	14	14	7	7	7	7A	14A	21	21A	214	28

A. Next higher frequency may be useful this hour.

B. Very difficult circuit this hour.

Good: 1, 4-9, 12-14, 19-22, 25, 26, 29-31

Fair: 10, 11, 15, 23, 24, 27, 28

Poor: 2, 3, 16-18

VHF: 1, 6-8, 14, 15, 18



73 Magazine

November 1967

Vol. XLVI No. 11

Jim Fisk WIDTY Editor

Kayla Bloom WØHJL Assistant Editor

Published by Wayne Green, W2NSD/I

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Cover by Bob Rogers

73 Magazine is published monthly by 73, Inc., Peterborough, N.H. 03458. The phone is 603-924-3873. Subscription rate: \$5.00 per year, \$9.00 for two years, \$12.00 for three years. Second class postage is paid at Peterborough, New Hampshire, and at additional mailing offices. Printed in Pontiac, Illinois, U.S.A. Entire contents copyright 1967 by 73, Inc. Postmasters, please send form 3579 to 73 Magazine, Peterborough, New Hampshire 03458.

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Trim for Ten						
The Longest QSO						
Death of Amateur Radio						
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Simple Modifications for the HW-12, 22 and 32DL4XO 80 Greater frequency coverage.						
Project Milk Wagon						
1 1 2 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2						
The Drake MN-4 Matching Network						
The Drake MN-4 Matching NetworkWIDTY 88						
The Drake MN-4 Matching Network						
The Drake MN-4 Matching Network						
The Drake MN-4 Matching Network						



Jim Fisk is on a much deserved vacation so this month's View comes from the assistant editor.

When I was in the seventh grade in school, the intercom came on one day with the announcement that anyone wishing to become a reporter for the school paper should report to room 201. Being firmly convinced that I was something of a literary genius, I reported to room 201 where I was given a test of sorts. I was assigned a bare set of facts about which I was to write a newspaper story. I not only did not become a reporter, I darned near flunked English as a result. So, here I am, some thirty years later . . . Not a reporter . . . The assistant editor of a national magazine, yet! The moral of this story escapes me at the moment, but it makes a good opener.

The life of an Editor is one fraught with danger. One ham magazine recently sold a part of their mailing list to a mailing house in California, in connection with some new ham gear publicity. Somehow, this list became confused with another similar list and 2,000 hams received blurb sheets on a new book about sex, while 2,000 non hams received information about the latest in ham gear. Naturally the editor gets blamed for the error. Then this same editor developed

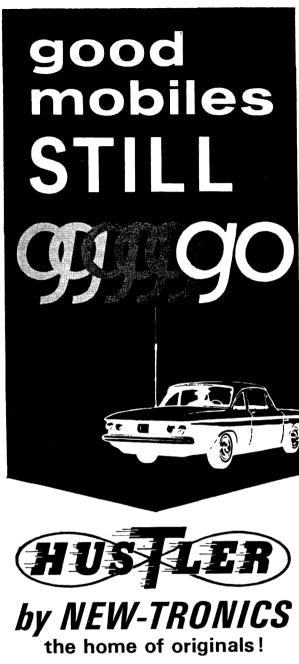
a severe case of foot-in-mouth disease and wrote an irate editorial demanding action from the FCC on the incentive licensing bit. You guessed it, the editorial reached the public after the bill had passed.

The first incidence could well have been avoided. It is common practice among magazines to either sell or rent their mailing lists as an added form of income. This is where all the junk mail comes from. A sells 2,000 names to B. B then sells this list to C . . . ad nauseum. The next thing you know, you are deluged with advertising for everything from Aardvarks to Zymoscopes. If the recipient of some bit of unsavory advertising can trace how his name reached this advertiser (usually the label is the same as some other more legitimate publication you regularly receive), there is a tendency to be slightly annoyed at his lack of privacy. I suspect what is gained in income from the sale of the mailing list, is probably offset by the number of subscribers who don't renew in objection. As you may have gathered, 73 does not release its subscriber list to anyone else.

Back to our unfortunate editor. In the matter of the poorly timed editorial, I can only feel compassion. These are the breaks sometimes, though. We all knew action was about to be taken on the incentive licensing in the very near future. Had the magazine come out on schedule, (about three and a half weeks earlier) think what a coup it would have been! The editorial comes out, then the FCC gets on the ball, and the readers say, "Boy, he really made them sit up and take notice." Well, you can't win them all, especially with the deadlines we have to meet to get things to the printer. Any editor who deals with current topics, takes the chance that the situation will change before his material gets into print.

Apropos of this, think of the new Callbook and how this will affect us. The latest issue has everyone listed with the class of license held. Unfortunately, due to meeting printing deadlines, transfer of information from FCC files, etc., the listings cannot possibly be kept current. There will always be the Technician who passes the General or Advance class exam, but remains listed in the Callbook for several months as a Tech. Until the records finally get caught up, he is going to be viewed with suspicion every time he gets on 20 meters. After the new regulations go into effect and there are further frequency re-

(Turn to page 128)



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The weekend DXers have been entertained and the serious DXers appalled by Don's selective system of avoiding contact with certain stations. His explanation of this was that he merely followed the DXCC rules which suggest that overseas operators not contact U.S. operators who are violating the rules of good sportsmanship. Others are convinced that he has been using this system to punish those on the DXCC Honor Roll for not "donating" to his expeditions.

John Scarvaci W9GIL sent questionnaires to 185 stateside Honor Roll members and got back 110 replies. This poll asked particularly about contacts with VO9BC/D. VQ9AA/D and VQ9AA/F. The BC expedition was by Bud Clabough and, though it was at about the same time as Don's trip to Des Roches, there was no connection. There was, I believe, a good deal of ill feeling, actually. The interesting thing is this: every fellow polled who tried was able to work both of the /D stations. Then Don went to /F Farquhar. Here the story was different. 47% of those who tried were unable to contact him, some keeping at it for as much as 50 hours over a four day period. Suddenly almost half the Honor Roll operators had become poor operators. And most startling of all, every single fellow who had donated to the expedition was able to get a contact with Don and not one of those who tried and failed had donated. The results of the poll leave little doubt that Don was using strong measures to force donations to his trip.

On page 60 of Don's document in answer to the ARRL complaints against him were reprinted two telegrams and one letter. The first telegram states that his Indian license had been issued as VU2WNV and for him to contact Brigadier Patel. The second states that the Vice Consul India, Nairobi, advises that he may operate from Laccadives as portable four. The letter, from the Ministry of Transport & Communications, grants permission for Don to operate from the Laccadives and is signed by V. M. Gogte and dated January 3rd, 1967. This series certainly appears straightforward and obviously proves that Don did have authorization to operate from the Loccadives as VU2WNV/4.

(Turn to page 120)

A Cheap and Easy Frequency Counter

If you want to know exactly what frequency you are operating on, the digital frequency counter is the only answer. This unit counts up to 100 kHz and costs less than \$50 to build.

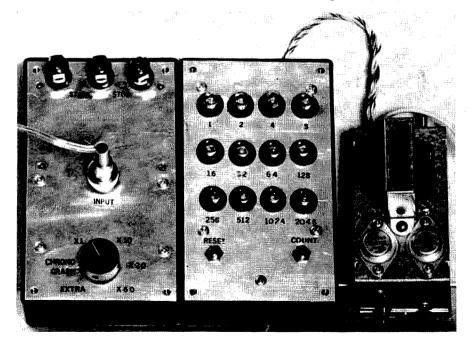
After reading numerous articles on integrated circuits and frequency counters, I decided that there should be a way to build a frequency counter which would be both simple and cheap. There was! It features 24 inexpensive IC's*, 15 surplus transistors, a frequency range from 20 Hz to 100 kHz (extendable), binary frequency readout and fully automatic operation. All you have to do is connect the input leads, turn it on, push the "count" button and read the frequency. In addition, this counter is small, takes less than a week to build, and costs less than \$50. Interested?

*Three Fairchild 914 IC's at 80¢ each and 21 Fairchild 923 flip-flops at \$1.50 each.

Uses

This counter has a number of standard uses, plus quite a number of special uses which I am still studying, and may report subsequently. Some of the more obvious are:

- 1) It can quickly and surely tune an audio oscillator. (I tuned a tuning fork with it to within 1/9th of a Hertz.)
- 2) I use it to tune teletype toroidal coils. (Build a small transistor oscillator that will use the coil and capacitor to be tuned, and then measure the frequency while substituting various capacitors.)
- 3) Check the amount of shift on a fsk signal. (Measure the mark signal; measure



Top view of the count indicator (middle), the count controller (left) and the power supply (right). The three terminals on the top of the count controller are used when the unit is used as a chronograph for measuring bullet speeds.

the space signal; subtracting the difference will give you the amount of shift.)

4) Measure the frequency drift of a receiver or transmitter. (Obtain a beat note from a stable source: measure and graph the resulting change in count.)

5) Check how far individual stations are off a net frequency. (Measure the beat note between a given station and a frequency

standard.)

6) May be used as a chronograph by gun and racing buffs. Feed in a known frequency by turning the counter on and off with start and stop traps and reading the counts, then convert to speed by using the following formula:

$$V = \frac{fd}{n}$$

where V =Speed in feet per second.

f = Frequency of source signal in Hertz.

d = Distance between traps in

n = Number of counts.

The count indicator

This counter consists of three fundamental sections: the count indicator, the count con-

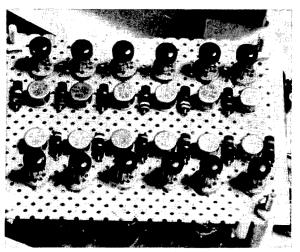
troller, and a power supply.

A count indicator may take any number of forms, depending on how complicated or complete you wish your counter to be. You may want the unit to give you decimal readout, since this is by far the simplest to read. However to build a decimal readout would add greatly to the complexity of the unit, as well as adding about \$50 to the cost. The alternate which I have chosen is one giving binary readout. This has the advantages of using the least number of parts to achieve a usable readout, it is simple to build, and not too difficult to read after you get used to adding the numbers. The version that I have built is one using 12 binary counting stages giving a possible count of 4097. What's binary? Well, let's take a look.

The various stages of the count indicator are consecutively labeled in powers of 2, starting with 2°, which has the value of 1.

At the start all bulbs are off. On the first

pulse, the "1" bulb turns on, the rest stay off. The second pulse turns the "1" bulb off and turns the "2" bulb on. The third pulse turns the "1" bulb on; the "2" bulb stays lit; and the rest stay off. Adding this total gives



Inside view of the count indicator, showing how the 12 stages of IC's and associated transistors are mounted on punched board which measures $3 \times 4\frac{1}{4}$ inches.

a count total of 3. The fourth pulse turns the "1" and "2" bulbs off and turns on the "4" bulb. The process continues for 12 stages on the model I have built, for a total count possibility of 4097 (one less than twice the value of the highest bulb in the counter). In summary, to read binary just add up the values assigned to the bulbs that are lit.

Construction of count indicator

If, in building this section, you put all of the parts in the same order and orientation that they have in the count indicator diagram, you will find that it can be built in just a few hours. I used integrated circuit sockets (miniature 8-pin), but you could just as easily solder them in. I bent the #4 pin up on all 12 sockets, and the #8 pin down. I then connected a wire between all of the #4 pins for a ground and minus lead, and another wire to all #8 pins for the +3.6 volt line. Next, run a wire from each #1 and #3 pin to the #4 pin, so all three pins are grounded. This completes the power wiring.

Next, connect all #6 pins to the reset button, and complete the wiring. The resistor in the base of each of the transistors may have to have its value juggled around a bit to make the bulbs glow evenly. Lowering the value makes the bulb brighter, and raising it dims them.

In the interest of simplicity, I mounted the indicator light bulbs on the front panel inside some grommets, as you can see in the picture. Instead of using sockets, I also soldered wires directly to the bulbs, and

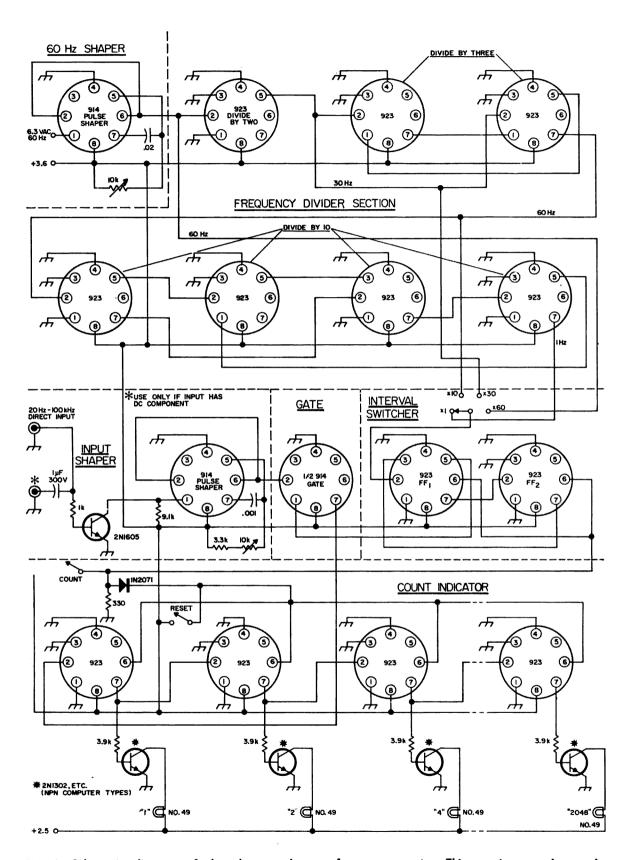


Fig. 1. Schematic diagram of the cheap and easy frequency counter. This counter uses inexpensive integrated circuits and costs less than \$50 to build.

adjusted the power supply so there is only about 1.5 volts across each bulb.

The count controller

To put it in the simplest terms, the count controller must turn the count indicator on for one second then off again, so as to see how many Hertz there were in that second of time.

The count controller consists of five sections. The main section is the one which forms the one-second interval. I achieved this by taking the 60 Hz ac line frequency, and dividing by 60. Though this could be done with multivibrator frequency dividers, I chose to divide by using the 923 flip-flops which frees me of any maladjustment problems which give an output frequency other than 1 Hz. This frequency divider also provides a 30 Hz and 10 Hz output.

Having these four frequencies then (60, 30, 10, and 1 Hz), we arrive at the second section, which is the key part. This is the interval switcher. This consists of two 923 flip-flops hooked up in a special way. Here is how it works:

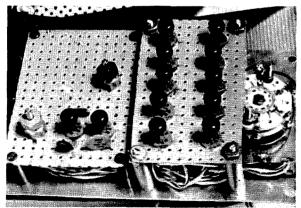
Both flip-flops are reset by the count button so that there is no voltage output at either pin #7. Upon releasing the count button, the next 1 Hz wave that goes to zero at the input of flip-flop number 1 (FF₁) will cause pin #7 to go positive, and pin #5 to go from its original positive to zero (these two pins are always at opposite states). When this happens, the count will begin to be registered on the count indicator. At the end of the next 1 Hz applied to FF₁, it will switch over to the state that it was at in the beginning, namely voltage on pin #5, but none on pin #7. This voltage on pin #5 will then cause the count to discontinue, with the last count registered on the count indicator. To prevent the next cycle from counting some more, another flip-flop, FF2, is so connected with FF1 pin #3 that the count is locked up until the count button is pushed once again, whereupon the whole process starts over.

An additional feature is the switch which can select various submultiples of 60 Hz, so that a count may be taken for 1/60, 1/30, 1/10, or 1 Hz. This means that the actual count will be the reciprocal of time counted times the count registered. For example, a count of 1000 on the count indicator taken in 1/30 of a Hz would equal an actual count

of 30,000.

The third main section is the gate, which allows the input to be coupled into the counter for the interval selected. This gate consists of one-half a Fairchild 914 dual twoinput gate. It consists of two transistors with a common collector resistor and separate base leads. When a positive voltage is applied to one transistor, it draws current and the resulting current will show almost no voltage at either collector, shutting down the other transistor in the IC. When the count is not to be taken, a positive voltage from FF₁ of the interval switcher is applied to one of the bases, thereby nullifying any signal which might be coming to the base of the other transistor in the gate. When a count is to be taken, the interval switcher goes to zero, allowing the count to go to the count indicator.

The fourth and fifth sections are similar, except that the fourth is better suited for the 60-Hz input, and the fifth is a pulse shaper, as is required to operate the flipflop. They are monostable oscillators which give a pulse of extremely fast rise time. The duration of the pulse is governed by the value of the capacitor. The higher the value of the capacitor, the better the monostable will work at a low frequency, hence the .02 mF in the 60 Hz shaper. On the other hand, a low value must be used for a high frequency input, hence the .001 in the input shaper so that the unit will go up to 100 kHz. If you wish to measure a higher frequency than this, then change this capacitor to a smaller value. To get better low frequency response, a 0.1 will provide response from several Hz to 20 kHz.



Inside of the count controller. At the right is the switch which selects the various ranges and functions. In the middle is the frequency divider section and interval switcher with gate. This punched board measures 31/4 x 2 inches.

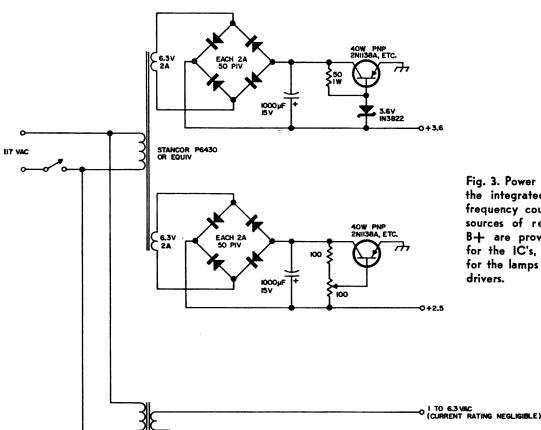


Fig. 3. Power supply for the integrated-circuit frequency counter. Two sources of regulated B+ are provided, one for the IC's, the other for the lamps and lamp

Construction of count controller

In general, the count controller is built and wired similarly to the count indicator. However, the wiring is a bit more involved to achieve the different modulus of 3 and 10. so care must be taken and the completed unit carefully checked for errors.

Power supply

This unit must supply three voltages, none of which is very critical. First of all, there must be 3.6 V to operate the various IC's. I have operated this unit from flashlight batteries—the voltage dropped to 2.3 volts before operation became erratic from one stage. At any rate, try to keep the voltage ±10% of 3.6 V and you will be assured of reliable operation. You will note that this power supply is only my way of arriving at the needed voltages, but there is a wide latitude of possibilities. In particular, the 60-Hz supply voltage to the frequency divider flip-flops is very non-critical due to the limiting nature of the pulse shaper it will feed into. Except for the 60-Hz voltage, the whole unit can be operated from dry cells.

Using the counter

After the normal checks for errors, hook

up the power supply and check for proper voltages. If desired, 3 volts from batteries may be used for the IC's and another threevolt supply may be used for the lamps.

By pushing the count button, with the switch on "XI", you should get the #1 lamp to light after a pause of 1-2 seconds with no input. If this happens, things are working. If not, then the 60-Hz shaper is adjusted incorrectly. The easiest and best way to adjust this is to put a scope on pin #2 or #6 of the 60-Hz shaper, and adjust the 10k pot until you have a dependable signal. You will find that this adjustment is not at all critical, and you may have hit it accidentally. When maladjusted, there will be no output appearing at the pins mentioned. Another way, not requiring a scope, is to adjust until you do have the #1 lamp come on every time with no input. (This is a feature of this circuit which tells you that the counter is working, but that you do not have sufficient input or that the input is not hooked up properly.)

After you have achieved a reliable "1" count, proceed to couple in a sinusoidal audio signal, preferably around 1 kHz at about 1 volt amplitude rms. Push the "count" button, and see if you get a count. If you

don't, then adjust the 10k pot in the input shaper section until you do. You will find that is it easier to check the unit if you have a known frequency and watch the counter count it. After getting a correct count, back off on the input ac voltage, and adjust the input shaper's potentiometer until you have the most sensitive setting. With the unit that I built, I get an input sensitivity of 0.1 volt from 700 Hz to 100 kHz. From 700 Hz to 20 Hz the minimum input requirements rise slowly, requiring 1 volt at 50 Hz and finally, 2.5 volts rms at 20 Hz. It does not overload up to 8 volts. Where possible, the input should be directly coupled rather

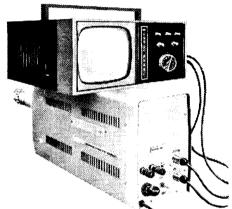
than through a decoupling capacitor. When the capacitor is used, the minimum input requirement at low frequencies goes up.

The lights are automatically reset to "0" when the "count" button is pushed. The purpose of the "reset" button is to extinguish the lights for standby.

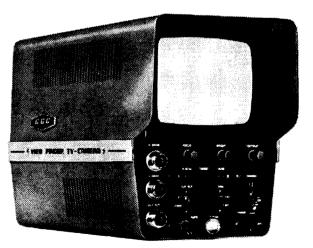
As mentioned at the beginning of the article, there are many number of uses for this little counter. After a little practice, and especially if you show the flashing lights to the children, you will find that this is one of the finest little units that you have ever built.

... W8NSO

Rube Goldberg would have liked this piggy-back arrangement...



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NOVEMBER 1967

Two Kilowatts PEP for 6 Meters

A complete transverter system from 10 meters.

Here is a system which is the ultimate for 6 meter SSB or CW. It puts out over 1 kW peak with less than 6 watts output from the exciter.

Forward scatter communication on the 6-meter band is very interesting. However, to make consistent contacts, near maximum power is required, along with the best antenna that can be used. This article covers construction of a 2 kW PEP final amplifier using the Eimac 4CX1000A along with a transverter from 28 MHz. This allows the operator to use a 10-meter transceiver or separate transmitter and receiver for the basic units. By using the low-frequency station and the 6-meter transverter, the band coverage is extended to 6 meters and the 4CX1000A final will operate very nicely at the full legal limit.

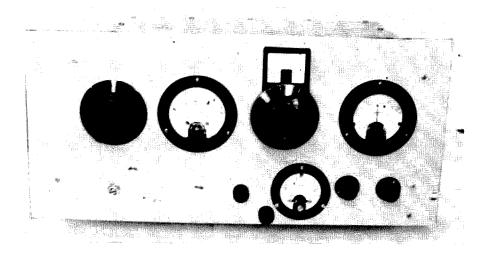
Circuit description

Transmitting converter

This transmitting converter is a much modified version of one which appeared in a magazine several years ago. This circuit is simple and very practical. Several styles have

been built and used at this station, but the one used in this article was the best approach. The circuit starts out with a 6U8 triode overtone oscillator operating at 22 MHz. Low plate voltage is used for good stability; the pentode section of the 6U8 is used for isolation and provides the proper injection voltage required for mixing. This is done by selecting the proper screen limiting resistor. Too much injection voltage will produce unwanted signals. It's better to use slightly less injection than required for maximum output. A 12BY7 is used for mixing, with the local oscillator signal injected into the control grid and the driving signal fed into the cathode. The unbypassed cathode resistor serves as a load, and also as operating bias for the tube; cutoff bias is used for standby only. The 6360 amplifier operates class A with cutoff bias on standby to prevent generating excessive heat and noise during receiving periods. A stiff resistance divider is used for screen voltage.

The tank circuits are adjusted for maximum output using a CW signal input from the exciter. The link coupling in and out of the 6360 amplifier must be adjusted for op-



Front view of 2 kW transverter, left to right: output loading, plate current, plate tuning, screen current; bottom: driver tuning, driver coupling, final-grid current, final-coupling, and grid tuning.

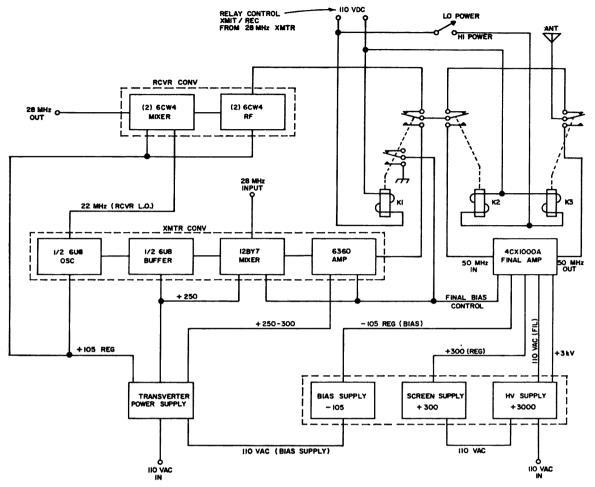


Fig. 1. Block diagram of the complete 2 kW PEP 6-meter transverter. Input and output are both at 28 MHz.

timum conditions, and maximum output of approximately 6 watts will be obtained. This power is more than sufficient to drive the 4CX1000A final, but can also be used for local contacts barefoot. Voltage requirements are as follows: 6360 B+, 250-300v; oscillator, +1050v; regulated mixer, +250v; and all filaments, -6.3v @ 2 amps.

Receiving converter

Two 6CW4 nuvistors are used in a cascode rf stage in a low-noise front end. This stage is neutralized by adjusting L3. Low plate voltage is used for best noise figure and still gives sufficient gain. A band-pass filter is used in front of the rf stage for added rejection of images, etc.

The mixer uses two 6CW4 tubes in a cascode configuration similar to the front end. The local oscillator signal is borrowed from the transmitting converter via a two-turn link on the oscillator plate coil and injected

into the grid of V3. Since the dynamic range of the cascode-connected stage is greater than a single grounded-cathode amplifier, over-load problems are reduced. The overall gain of this converter is still more than needed, even with low B+ voltage applied.

This amplifier uses a standard, single-ended circuit, with a tuned input and is neutralized for best stability. This adds to the suppression of spurious signals and requires much less driving power than the passive grid method (only 3 watts drive is required). A high-capacitance and low-inductance grid circuit is used. Because of the high grid-to-cathode capacitance, a series-tuned input using approximately 75 pF for tuning is used. This will allow good balance of the input circuit and gives a proper match to the grid input.

A pi-network output, using a high-Q inductor, is used to reject harmonics. This

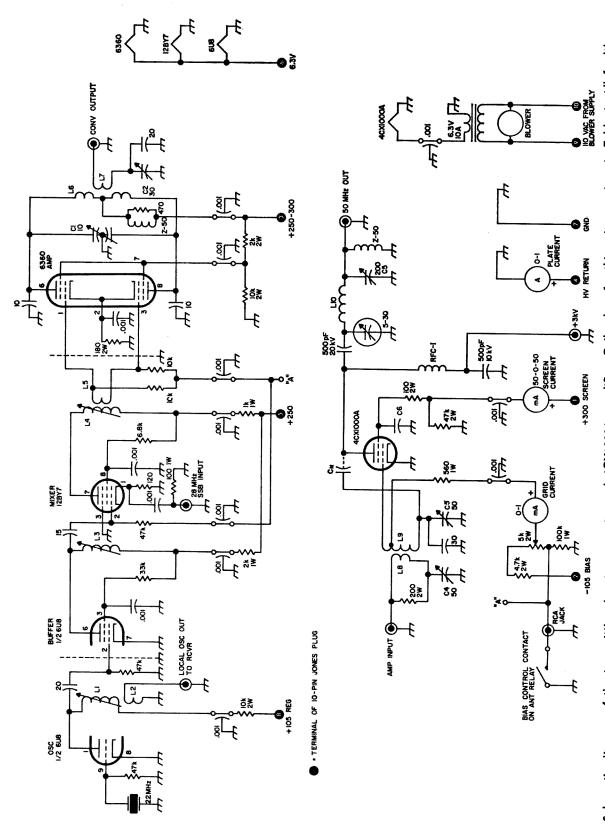


Fig. 2. Schematic diagram of the transmitting 6-meter converter and 4CX1000A amplifier. Coil values for this unit are given in Table 1. All feedthrus are .001 ceramic.

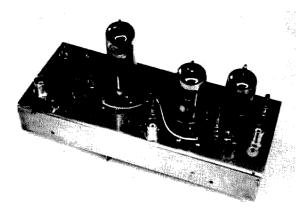
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helps alleviate the TVI problem. A vacuum variable capacitor is used for plate tuning, but if one is not available, a standard transmitting capacitor of good quality will do just as well. A Johnson 250 pF variable is used on the output. The voltage at this point is low, so the plate spacing can be less than in the plate circuit.

Separate metering was used for grid, plate and screen. A 50-0-50 mA was used in the screen. Depending upon loading, the screen current can vary from 0 to-20 mA and as high as +20 mA. A small bleeder, along with a series resistor, was used at the screen of the tube to prevent feedback and to keep the impedance low at all times. Screen decoupling is recommended on all tubes of this type.

The grid compartment is enclosed in a box and feedthru capacitors are used to provide isolation on all dc and heater leads. A large blower keeps the tube at a low operating temperature. The amplifier was run continuously at 2400 watts dc input and after turning it off and checking it immediately, the tube was just warm.

Filament voltage to the 4CX1000A must be adjusted to 6.0 volts. This, of course, will provide long life by preventing excessive back heating of the cathode. This tube must be operated in class AB1 with peaks of less than 1 mA grid current. A 1 mA grid-current meter is used for monitoring. At approximately 500 grid μ A the tube goes into dis-



Transmitting converter. Top view showing the solderin feedthru capacitors and general dc wiring.

tortion; at this point the screen should show positive current. With 300 volts screen voltage and B+ of 3000 volts this amplifier is linear well beyond the 2 kW legal limit; plate efficiency is 55% or better. Cut-off bias is used on both the final and the transmitting converter. This bias level is switched by a set of contacts on T-R relay.

Construction details

Transmitting converter

This transmitting converter is built on a U-shaped chassis formed from brass sheet stock. This chassis fits in the bottom of the 3-inch main chassis as shown in the photos. A hole layout is provided for locating major parts (Fig. 5).

All de wiring is located on the outside of

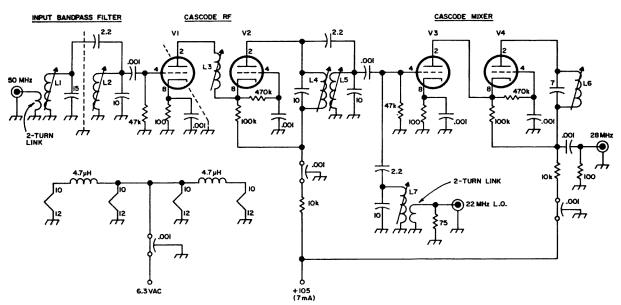


Fig. 3. The six-meter converter section of the 2 kW PEP transverter. The cascode rf amplifier uses two 6CW4's for maximum performance. The 22-MHz local oscillator input is picked up from the transmitting convert. Coil values are given in Table 2. All tubes are 6CW4/6DS4.

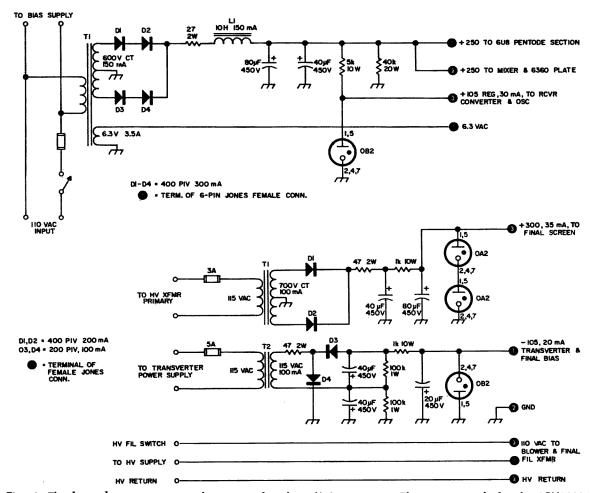


Fig. 4. The low-voltage power supply section for the 2 kW transverter. The power supply for the 4CX1000A is left up to the individual builder—its controls are shown in Fig. 7.

the chassis for simplicity and better circuit stability. Feedthru capacitors are used for by-passing. These capacitors can be a good quality solder-in or threaded type. The holes, of course, must be drilled for the type available. A cover is fabricated from brass and is soldered on. This transmitting converter is mounted inside the main chassis with long shafts brought out to the front panel for peaking at various frequencies in the band. The converter should be tested prior to installation in the main chassis. Be sure to locate the crystal away from any hot tubes, etc.

The input and output are connected by using BNC jacks on the transmitting converter chassis, and short cables are run to the rear of the main chassis. All switching is done with relays outside the chassis.

Receiving converter

The receiving converter is constructed on a chassis formed from brass (same as be-

fore) with a partition to separate the dc from the rf side as shown in Fig. 6. Shields are used to isolate the stages. Refer to the photos for parts placement and chassis layout. Be sure to use short connections and good VHF construction practices. This converter has outperformed all others used previously, and takes an extremely strong signal to produce cross-modulation products.

Main chassis and final amplifier

A large 11" x 17" x 3" chassis is used for the complete transverter. The final plate compartment was fabricated from parts of BC-375 tuning units cut down to a 15¼" x 7¼" x 4¾" box with a perforated cover. If metal working tools are available the builder can fabricate his own. An 8¾ x 19 inch front panel contains the meters and all the controls.

The grid and screen circuitry is enclosed by a 8 x 6 x 12 inch inverted chassis which

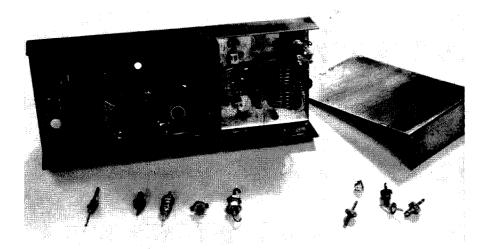


Photo showing inside of transmitting converter. Various capacitors in foreground show a few of many styles which are available for VHF/UHF use.

shields the input, and provides an air tight compartment for cooling the tube. Feedthru capacitors are used for rf suppression on the dc leads. Filament power is supplied by a 3.6V, 10-amp transformer mounted on the main chassis. The final plate coil is formed from 3 turns of %-inch copper tubing with a 2-inch inside diameter, 3½ inches long. This makes a sturdy inductor and is supported by the plate and output tuning capacitors. Plate voltage is fed through RG-8/U coax, and high voltage fittings are used at the ends. The plate rf choke was constructed by winding 2 inches of #26 wire on a 1/2-inch ceramic stand off. A 500-pF TV door knob capacitor is used for the HV bypass. The plate blocking capacitor is a 500-pF high-current type, such as those used in most commercial systems.

The description given in this article will help the builder whether he copies this layout or simply uses it for generating his own

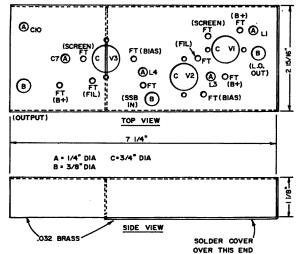


Fig. 5. Chassis layout for the six-meter transmitting converter. The "FT" indicates the location of feed-through capacitors.

ideas. I find most hams would like to use their own imagination.

The receiving converter is attached to the rear of the main chassis. This allows adjustments to be made and allows the cables to be made shorter. The transmitting converter, as stated before, is mounted inside the main chassis. With the system complete, a large cover with ventilating holes is installed over the bottom of the main chassis.

Control circuits

Provision for high or low power was incorporated in this system. When working local stations there is no need to use 2 kW PEP; the exciter output of 6 watts is adequate. Three coax relays were used to provide the switching, allowing the transverter to be used without turning on the final. The relays used were 110 V dc; however, the builder may use any relays he has available. The block diagram in Fig. 1 shows the arrangement for this high/low power switching.

Power supplies

Power supplies were built on separate chassis. The transverter supply was built as a complete unit and delivers the following voltages: +105 V for V1 oscillator plate and the receiving converter; +250 V for the mixer and driver; and 6.3 V ac for all the transverter filaments. It also provides bias for the transmitting converter. The final screen supply was constructed on a small chassis and mounted next to the high-voltage supply. The final uses the following voltages: -105 V bias; +300 V @ 40 mA for the screen; and high voltage of +3000 V@ 700 mA. The power supply circuits shown are mainly for reference, as most hams have

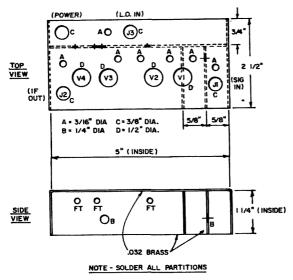


Fig. 6. Chassis layout for the 6-meter converter chassis.

transformers of different ratings available. Well filtered and regulated supplies help to make a clean signal. Refer to the various handbooks for additional information.

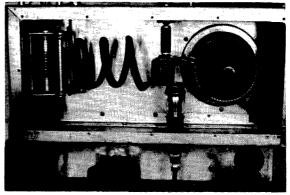
A word of caution, use extreme care around the high voltages. One slip and thats all! You don't get a second chance. Use a heavy insulated screw driver to short out the B+ line before touching the innards.

Adjustment and operation

Transmitting converter

The transmitting converter should be tested prior to installing it in the main chassis. This is done as follows: using a grid-

dip meter, preset all coils for the proper frequencies. Next, with a crystal connected to the oscillator, apply power and, using the grid dip meter in the diode position, peak up the local oscillator and buffer for maximum indication. Now drive can be applied to the mixer cathode. The output of the 6360 should be connected to a dummy load or wattmeter and all adjustments peaked for maximum output at 6 meters. Also adjust the coupling links at this time. The 6U8 screen resistor should be adjusted for a slight reduction in output power to insure minimum spurious signals. The rf output should now be approximately 6 watts. The cover can now be installed over the local oscillator and mixer section. Readjustment of these circuits is unnecessary; this completes the transmitting converter checkout.



Top view showing the inside of the final plate compartment. The high-Q tank circuit provides good stability. The strap in the lower right corner is used for neutralization. A homemade rf choke is supported by the door knob capacitor on the rear wall.

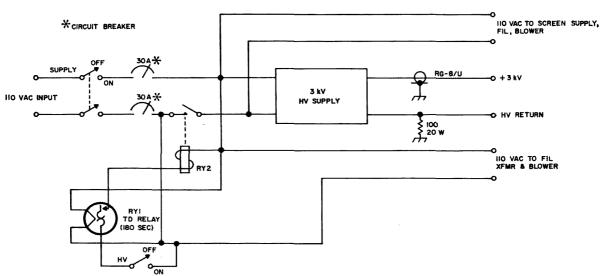
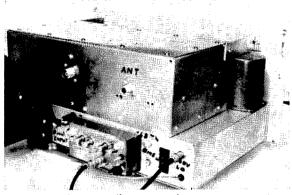


Fig. 7. High-voltage power supply controls which are used in the 4CX1000A transverter. The 3000-volt high-voltage supply is not shown since most builders will use what they have available in the junk box.



Rear view showing all input and output connections. The receiving front end on the rear of chassis allows for adjustment and ventilation. Large compartment is constructed from parts of two BC-375 tuning units with a perforated cover.

Receiving converter

Local oscillator injection is required either from the transmitting converter or another source, while adjusting. The method for this converter is very simple and just requires peaking, using a stable signal such as a 100 kHz marker or a received signal on the air. The bandpass filter can be adjusted for the desired response; however, at this station, all operating is done in the lowest 150 kHz of 6 meters.

Final adjustment and neutralization

The indivdual units should be checked out prior to installation to insure that the transverter section is working properly. When construction is complete, filament power and cooling can be applied to the final amplifier. Be sure the plate and screen leads are open circuited to prevent rectification in the screen and plate circuits.

Connect a detector and VTVM to the output connector along with a 50-ohm load. Now apply the driving power, adjust the level to about 500 mA on the grid meter, peak plate tuning and output loading for maximum level on the VTVM, adjust the neutralizing strap near the final tube for minimum level and check again to make sure the grid tuning is still set for maximum output. This procedure may have to be repeated several times. Once the final is properly neutralized, the amplifier will operate very smoothly. The power output will peak at about minimum plate current. One word of caution-be sure the screen voltage is never applied without plate voltage, or the screen will draw excessive current. In normal operation the final will load to about 800 mA maximum with a very slight indication of grid current. While bench testing the final, the watt meter was pegged on the 1200-watt scale. With 1200 watts output, the plate input was 1960 watts dc. Running continuously, the amplifier showed no signs of strain or detuning.

Summary

This system has proved to be very good. A lot of stations have been worked every weekend using forward scatter techniques. The exciter and receiver at this station have both transceive and separate frequency capabilities, which really makes this system a dream to use.

While using the amplifier on the air, precautions should be taken so the amplifier does not exceed 2 kW PEP as limited by regulations.

. . . K6RIL

Table 1. Coil, choke and capacitor data for the transmitting converter.

- CI 10 pF butterfly variable. Johnson 160-211.
 C2 30 pF single section. Johnson 160-130
- C2 30 pF single section. Johnson 160-130. C3, C4 50 pF variable. Hammarlund HF-50.
- C3, C4 50 pF variable. Hammarlund HF-50. C5 250 pF variable. Johnson E[54-1.
- C6 Screen bypass capacitor built into 4CX-1000A socket.
- L1, L3 28 turns number 28 enameled on 3/8" slug-tuned form.
- L2 2 turns number 24 insulated; wound on form below L1.
- L4 13 turns number 22 enameled on 3/8" slugtuned form.
- L5 3 turns number 24 insulated wound around center of L4.
- L6 10 turns number 14 tinned, 34" ID. Spaced at center for L7.
- L7 2 turns number 14 enameled, ¾" ID. Adjust so it is inserted halfway into L6.
- L8 3 turns number 12, 11/4" ID, wound around center of L9.
- L9 4 turns number 10, 1" OD. Tap at one turn from ground.
- L10 3 turns 3/8" copper tubing, 2" ID, 31/2" long.
- RFC1 60 turns number 25 enameled. Wound 2" long on 1/2" ceramic insulator.

Table 2. Coil data for the receiver converter shown in Fig. 3.

- LI-L5 10 turns number 26 on 1/4" slug-tuned form (white slug). The antenna is coupled to L1 through a 2-turn link around the cold end.
- L6 26 turns number 28 on 1/4" slug-tuned form (red or green slug).
- L7 29 turns number 28 on 1/4" slug-tuned form (red or green slug). Link consists of 2 turns wound around the cold end.

A Pulse Generator for the Amateur

An integrated-circuit design for testing transmitters, receivers, audio and ATV equipment.

"What would a ham want a pulse generator for?" asks the amateur operator. "We're not in the radar business; pulses are what we want to eliminate, not generate!" Well, first let's find out what pulses are; and then find what hams can do with them.

Webster says that a pulse (as the word applies to "radio") is "an electromagnetic wave or modulation thereof, of brief duration". This definition allows us a great deal of latitude. However, the author feels that when most electronics-oriented people see the word "pulse" they think of a rectangular wave whose "on" time is short compared to its period.

A pulse train is shown in Fig. 1, where to is the "on" time, and to is the period, or distance between similar points on adjacent pulses. A pulse is not required, in general, to be rectangular; it may have any of a variety of shapes, like those shown in Fig. 2. These special-purpose pulses are sometimes used in pulse systems where it is desired to carefully control the bandwidth of the pulse signal. A pulse generator that will produce all of the pulses of Fig. 2 is not within the scope of this article; so we'll stick to the common rectangular pulses of Fig. 1.

Perhaps the simplest pulse generator known to solid-state-electronics is the unijunction relaxation oscillator, as shown in Fig. 3. It puts out a train of pulses whose repetition rate $(1/t_p)$ is controlled by R_1 and C_1 and whose "on" time (t_0) is controlled

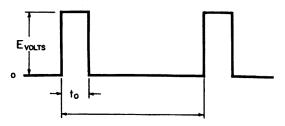


Fig. 1. A typical pulse train. The time $t_{\rm o}$ is the "on" time, and $t_{\rm p}$ is the period.

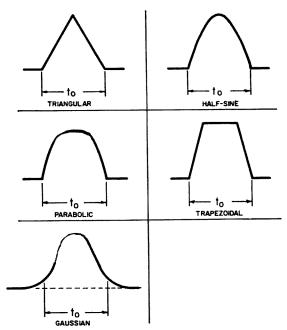


Fig. 2. Other pulse shapes which may be encountered—triangular, half-sine, parabolic, trapezoidal and gaussian.

by R₂ and C₁. This simple circuit can provide a timing pulse for everything from an electronic metronome to a "V.T." fuse. With a few slight modifications, the unijunction relaxation oscillator can be synchronized and the R-C charging of the emitter-capacitor modified to linear charging.²

Since the circuit of Fig. 3 produces a pulse of rather short duration, we can use it to trigger a monostable multi-vibrator to obtain longer pulses. It is in such service that the monostable multivibrator is called a "pulse-stretcher". A realization of this simple unijunction-plus-monostable multivibrator type of pulse generator is shown in Fig. 4. A pulse amplifier was added between the unijunction section and the monostable multivibrator to provide both isolation and the level shift necessary. The values shown in Fig. 4 will give pulse repetition frequencies (PRF's) of 100 to 1000 Hz and

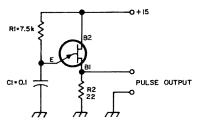


Fig. 3. A simple unijunction transistor relaxation oscillator which will generate the pulse chain. The pulse repetition rate is determined by RI and CI; the on time is controlled by R2 and CI.

pulse widths of 30 µsec to 500 µsec. The values of R₁C₁ and R₂C₂ could be switched to provide other PRF's and pulse lengths. In spite of the fact that this simple pulse generator has only five semiconductor packages and about a dozen other components, it is a very useful unit to have around the shack.

The "sync" connection to the circuit can be either used as a sync output or sync input. A negative-going wave, from a low impedance source, put *into* the sync port will synchronize the pulse generator. Or, a negative-going pulse may be taken out from this same "sync" port. The pulse generator can be synchronized by waveforms which are multiples of its free-running frequency, and used as a divide-by-n unit.

The simple pulse generator of Fig. 4 can be vastly improved upon, to create a general-use amateur model. Such a pulse generator is shown in Fig. 5. By replacing the unijunction oscillator with one using an HEP 556 integrated circuit, the need for both +15V and +6V as circuit supply voltages is eliminated. Only +6V must be supplied to this more versatile pulse generator.

Since the HEP 556 (a three-input ECL gate) oscillator puts out a rectangular waveform that has a logic level which is compatible with the HEP 558, no isolation am-

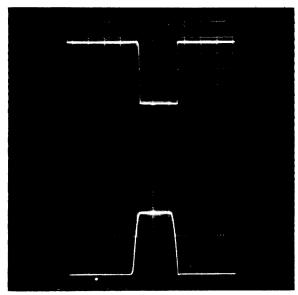


Fig. 6 Output waveform of the circuit in Fig. 5 for minimum pulse width. The sweep speed of the oscilloscope is I μ second per division.

plifier is necessary. The first HEP 558 is used as a delay generator. This delay generator is a monostable multivibrator whose output pulse triggers the following stage at the *end* of its pulse. The second HEP 558, also connected as a monostable multivibrator, is the pulse generator.

To add versatility, several other transistors have been added: a split-load phase inverter, two output amplifiers, and a sync output emitter-follower.

The waveforms in **Fig. 6** show the two (complimentary) outputs when the generator is asked to produce its narrowest pulse. This narrow pulse clearly shows the rise times to be expected of our generator.

The output pulse is available either as a positive-going pulse starting near zero and going to nearly +6 volts, or the compliment of this. The compliment, of course, is a negative-going pulse starting near +6 volts and going to nearly zero.

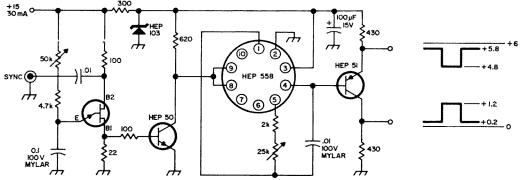


Fig. 4. In this pulse generator, a pulse amplifier has been added to the simple unijunction relaxation oscillator to provide isolation and the necessary shift level.

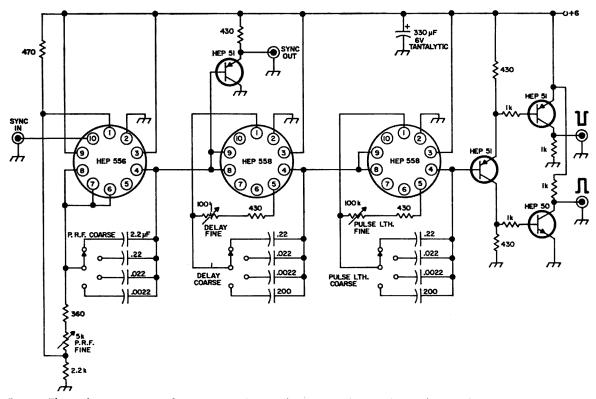


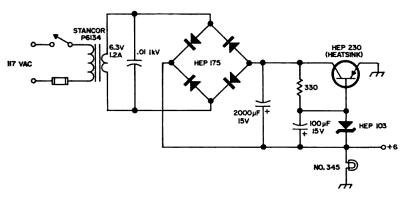
Fig. 5. The pulse generator of Fig. 4 can be vastly improved upon by replacing the uniquaction transistor circuit with an integrated circuit. This pulse generator will provide complimentary outputs, variable pulse length, variable pulse repetition frequency and variable pulse delay. It will drive a capacitive-coupled 500-ohm load.

By switching the "pulse length" switch to "SQ", the monostable multivibrator, which forms the pulses, becomes a simple ÷2 flip-flop. In this mode, nearly perfect square waves are produced from 10 Hz to 100 kHz—just one half the normal PRF rate. This feature was added, because it was so simple; the monostable multivibrators which perform the "delay" and "pulse length" functions are basically flip-flops modified for monostable use.³

In the interest of simplicity, the four ports of the pulse generator are direct-coupled. Coupling capacitors, of proper size to accommodate the particular pulse one is using, can be added externally. Alternately, a series dry cell or battery can be used to adjust levels; these are best used externally.

The finished pulse generator is shown in Fig. 7 and 8. The generator was built in a Bud cabinet (CD-1480) for two reasons. Firstly, this was the cabinet the author had on hand, and secondly, the 8" x 8" panel allows enough room to mount all the controls. The circuit board picture, Fig. 8, shows all the generator circuitry except the power-supply. Obviously there is room to spare, and a much smaller unit could be built if miniature switches and pots were used.

Now that we've generated our pulses, let's



A regulated power supply for the pulse generator shown in Fig. 5.

have a look at their uses. The most commonly used "pulse" is the square wave, which the second pulse generator will produce. Square waves are widely used to performance-check audio amplifiers; an elementary description of this is given in the "Motorola Integrated Circuit Projects Handbook."4 A more thorough section on square wave and pulse testing of amplifiers is given in reference 5.

Since the radio telegraph, radio teletype, and television modes of transmission are all based on pulse sequences, a pulse generator can be useful in the design, simulation, and testing of amateur equipment for these modes. The exact nature of the use of the pulse will depend on what the user is trying to do. If he wished to turn on a transmitter with the pulse, we'd call it "pulse (amplitude) modulation". If he wishes to turn a signal off with a pulse, we'd call it "blanking". Or turning a signal on for a desired time interval, after a desired interval would involve "delaying" and "gating". Of course, the uses of combinations of these functions are limited only by the imagination.

... W6GXN

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1. "Webster's New Collegiate Dictionary", 1961, C & C Merriam Co., p. 685.

2. "General Electric Transistor Handbook", 7th Edi-

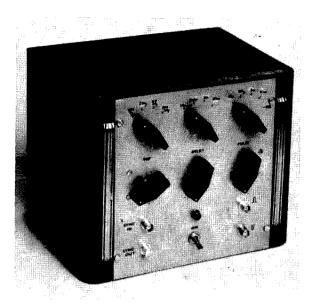


Fig. 7 The pulse generator. This unit uses integrated circuits and transistors to provide pulse repitition rates from 20 Hz to 200 kHz, pulse delays from 20 microseconds to 20 milliseconds and pulse widths from 20 microseconds to 20 milliseconds. A square wave output is also available.

tion, 1964, p. 312-320.

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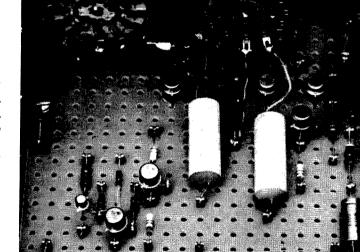


Fig. 8 Circuit board used in the pulse generator shown in Fig. 7. All components are mounted on this board except the power supply.



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Magnetic tape, 7" reel, dual track, 2 hours. Immediate delivery. Send check or money order. (Specify which tape.) \$6.35 each.

Mighty Four on Six

A low cost, four transistor transmitter for six meters.

Here is a transistorized transmitter for six meters which is small in size (2¹³/₁₆" by 2"), complete with modulator, but still capable of putting out a very respectable signal. The modulator uses no transformers, and has a small 1½" speaker as the microphone. Only four low-cost transistors are used, and actual on-the-air reports indicate excellent performance.

The transistors specified are slightly unconventional, in that the Motorola MPS6516, used for the two modulator stages and for the 50 MHz crystal oscillator stage, are low cost (60¢), general purpose audio, and low frequency types. However, due to an f_T of better than 200 MHz specified on the data sheets, it will work nicely as a 50 MHz oscillator. Higher gain can be achieved by using transistors from this same family, such as the MPS 6517 through MPS 6523, but was found unnecessary on the two units built.

The output stage is run in grounded collector, with a slightly unconventional output. Normally a circuit such as this employs a pi output network in place of the tank shown in Fig. 1 as L_s-C₅. Since this transmitter was to be used with only a 50-ohm antenna, and to keep dissipation to a minimum, a fixed tank circuit was used. The output transistor is a Motorola MPS 6531 plastic transistor, rated at 310 milliwatts dissipation at 25°C ambient temperature. However, as will be seen later, it will take more if certain precautions are adhered to. Again, this transistor, from the data sheets, is sold for use in complimentary audio output stages. However, the fr on this one is 390 MHz with a maximum collector current of 600 mA. The price is 75e.

Table 1 shows the results which can be obtained with the transmitter. Several points of caution should be noted. First, a heat sink must be used on the output transistor. The results shown were obtained with a small heat sink measuring only ½" by ¾". A suitable heat sink may be made by cutting a ½" strip approximately 1¾" long from the top of that next tin can you open. If you have a pair of small needle-nose pliers around, they'll serve nicely as the form for bending the heatsink. The shape of the MPS 6531 corresponds to this.

The second word of caution is not to use modulation with the 24 volt supply. On modulation peaks, the final may go poof. Increasing R₀ would probably reduce this chance, but due to the dissipation involved, phone operation isn't recommended at this voltage. Using it as a CW transmitter at this voltage is all right because the final really doesn't get a chance to heat up sufficiently to destroy the transistor.

If no modulation is obtained at the 9-volt level, removing R_{α} and then soldering a piece of wire in its place should restore modulation. No trouble has been experienced, however, from 12 volts and up.

As can be seen in Table 1, the output power of the transmitter at 12 V and up, should be sufficient to drive a tube such as a 6146. Again, 24-volt operation isn't recommended, due to dissipation. Notice also how the efficiency drops off as you raise the voltage. Optimum performance seems to be between 12 and 15 volts for AM operation.

With modulation, the total drain goes up and can be as high as 200 mA on peaks at the 18 V level, but batteries the size of D

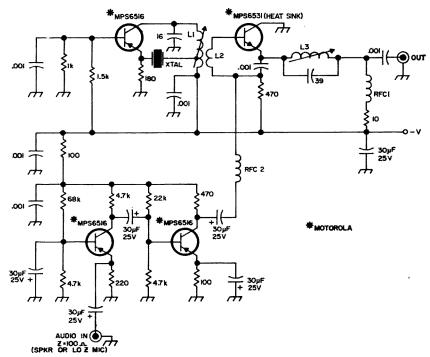


Fig. 1. Schematic diagram of the six meter transmitter employing four low cost audio transistors.

cells would be sufficient for portable opera-

The circuit shown is for positive ground, however NPN's, such as the Motorola MPS 6513, could be substituted for the PNP MPS 6516, and a PNP, such as the Motorola MPS 6533, substituted for the MPS 6531 by reversing the power supply leads. Comparable performance should be achieved.

Construction and testing

Fig. 2 shows the suggested printed circuit layout for the transmitter. The foil side is shown in 2A and the parts layout in 2B. In order to condense the size, all resistors are standing up on the board.

To build strictly for CW, but still have the option for phone operation later, just do not connect R_a and RFC 2.

Instead of wasting money on a crystal socket, I used two pins out of a miniature 9-pin tube socket. These make a very good substitute for a crystal socket. If you're really brave (and rich), I suppose you could solder the crystal directly in, but its too easy

to destroy the crystal.

The coil form for the oscillator stage was a plastic form, but could be ceramic or phenolic. A ¼" form would probably work just as well.

Build up the oscillator stage first. Using a grid dipper (or a receiver tuned to six meters), check to insure the stage is oscillating at 50 MHz. Don't worry about tuning this stage up at this time, as it'll only change when you work on the final.

Next, build the final stage. Temporarily solder only one end of R₅ (the end which goes to RFC 1). This is the 10 ohm resistor. Insert a milliameter in series with the resistor and the power supply leads.

If possible, start with no higher than 9 V initially. With voltage applied, an indication of current should now be seen. If it isn't, tune the oscillator. When current is evident, tune the oscillator stage for maximum reading on the milliameter. If no reading is obtained, reverse the leads on L₂.

Next, using an insulated tool, spread or squeeze the turns on L₃ as necessary, watch-

9 volts	12 voits	15 voits	18 voits	24 voits
Final Current 24 mA	39 mA	49 mA	60 mA	83 mA
Power in216 mw	470 mw	735 mw	1.080 watts	1.980 watts
Power out138 mw	296 mw	408 mw	560 mw	795 mw
Dissipation 78 mw	174 mw	327 mw	520 mw	1.185 watts
Efficiency 64%	63%	55.5%	52%	40%
Total Circuit Drain 50 mA No Modulation	73 mA	90 mA	IIO mA	145 mA

Table 1. Performance of the Mighty Four on Six with various power supply voltages.

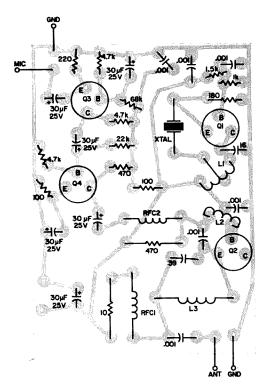


Fig. 2 Suggested printed circuit board for the transmitter. The foil side is shown in 2A and the parts location in 2B.

ing the meter for minimum current. Repeat several times until you're sure you have

maximum drive from the oscillator and minimum current in the final.

As mentioned previously, the output is slightly unconventional. Tuned up in this manner, the dissipation is kept down, but doesn't produce the maximum output. At a sacrifice in dissipation, the output can be greatly detuned (for instance—removal of C₅) and more output achieved. Make sure, of course, that you have a 50-ohm dummy load connected while tuning. The results shown in **Table 1** will give you some idea of the current to expect.

Finally, build up the modulator section, connect a 75- to 100-ohm speaker, and apply voltage again. Check with a receiver to tell quickly if the modulator is working. The meter, in series with R₅, should show some deflection with modulation.

With a low-impedance dynamic mike, you may have to increase R₀ somewhat for best modulation. A scope check on modulation showed that close to 100% modulation was obtained fairly easily, so a check wouldn't hurt if you have a scope available.

Next time someone asks you what your rig is, you can tell them that you're running four audio transistors to the antenna—the Mighty Four on Six, that is.

. . . **K**9VXL

Vector 25X Experimenter's Kit

There's an unrecognized bargain on the market in the form of Vector's 25X Experimenter's Chassis Kit. This collection of hardware goes for about \$20, and somehow their Sales Department has let it go with a really inadequate description. When I received one of these kits, the first thing I noticed was its considerable weight. Further investigation showed the Vector Co. has succeeded in putting a little bit of almost everything into it, without making quantities so small as to be hints rather than helpful.

The materials provided are about equally distributed between supplies for vacuum tubes and for solid-state breadboarding. Several different varieties of spring clip and solder lugs are included. A large piece of Vector board and four heavy aluminum channels make up a chassis-like structure and suggest more elaborate assemblies. Mounting materials for both small and power transistors, a quantity of wire, some push-on interconnect-

ing leads, and many smaller items are also included. The tube sockets and mounting assemblies may seem a little inappropriate, but after all, we are still using a lot of tubes.

Perhaps "Basic Laboratory Kit" would have been a more descriptive title. Everything can be replaced from Vector or from general stock in order for the kit to remain useful indefinitely. A couple of mighty handy tools are thrown in for good measure. All this looks like a good thing for the fellow who likes to design his own gear, and for the beginner who needs to get a quick look at lots of circuits without getting carried away by any of them.

The 25X Experimenter's Kit is listed in Allied Electronics, Burstein-Applebee, and in Cramer Electronics catalogs. Some less expensive but simpler kits are also listed in these, and in the Lafayette Radio catalogs. You can find them easily from the manufacturer's index: Vector. ... W2DXH

Incentive Licensing

The report we had last month on incentive licensing was of necessity quite brief since it came out just before we went to press. Here is the complete story.

On the 24th of August the Federal Communications Commission adopted an amendment to the Amateur Radio Service Rules for incentive licensing. As we noted in our brief report last month, the new regulations include a new class of license, the Advanced Class, exclusive band segments for the Amateur Extra and Advanced Class licensees, a two-year Novice license term and deletion of Novice radiotelephone privileges on two meters.

In adopting the new regulations, the Commission noted that, in addition to comments filed by organized amateur groups, over 1700 formal comments representing the views of about 4000 licensees were received in response to the Notice of Proposed Rule Making issued in April, 1965. Each of these comments were considered, and since the majority were written in an intelligent and thoughtful manner, they were very helpful.

It is interesting to note that the proposed incentive licensing program was endorsed by two out of every three of the comments. The favorable comments supported the Commission's view that, in order to justify the continued allocation to the Amateur Radio Service of a substantial portion of the spectrum in the face of the incessant and important demands of the other radio services, there must be continuing movement towards the goals set forth in Section 97.1 of the Rules. Namely, "Encouragement and improvement of the amateur radio service through rules which provide for advancing skills in both the communication and technical phases of the radio art."

The main arguments against the proposal which were received were apparently based on the contention that an incentive licensing program would have no long-range effect. It was felt that the amateurs who studied for the higher classes of licenses would fall back to their old level of proficiency and competence after achieving the higher license. The Commission did not accept this view because education and training in any field of endeavor leads to a certain amount of per-

manent improvement. They concluded that an amateur who develops his skills and increases his knowledge to the extent required for the higher class license would retain a significant amount of that proficiency and learning.

New Advanced Class

Many of the comments recommended that the Advanced Class licensees be granted "grandfather" privileges to the new higher class license. Since these licensees qualified by examination for the incentive privileges in effect prior to 1952, and have had at least 15 years operating experience, they presumably have the qualities which incentive licensing is trying to foster. Accordingly, the Commission adopted the recommendation for "grandfather" rights to the new license. Present holders of the Advanced Class license will be renewed as such with all the privileges and status pertaining to the new Advanced Class license.

A large number of comments in favor of the new license suggested that it be made available to any lower class licensee without a one year waiting period. They contended that, although the primary purpose of the incentive licensing proposal was to encourage licensees to upgrade, it would actually discourage them by imposing license tenure and waiting time requirements. Also, it was frequently recommended that the proposed 16 word per minute code test requirement for the new license be reduced to 13 words per minute, the requirement for the General and Conditional Class licenses. In most cases the basis for this recommendation was that an increased code speed bears little relationship to the radio-telephone privileges which were proposed for holders of the new higher grade license. Therefore, the increased code speed requirement would present an unwarranted deterrent to obtaining the new Advanced license.

Since both of these suggestions were considered valid by the Commission, the new Advanced Class license will be available

to any eligible applicant who successfully passes a code test of 13 words per minute and a written examination. Since the code test is 13 words per minute, code test credit, as well as credit for those parts of the written examination which are required for the General Class license, will be given to applicants who hold the General Class license.

Amateur Extra Class

In view of the new higher class of license, the Commission, in its Notice of Proposed Rule Making, invited comments as to whether there was sufficient interest and utility in the retention of the Amateur Extra Class license. Most of the comments in this regard urged continuation of the Amateur Extra Class. As one comment noted, "It's utility is logical with respect to the proposed Amateur First Class license in that it offers further opportunity for individual maturation . . . " In addition, the Commission noted that the number of Amateur Extra Class licensees increased a little over 25% in little more than a vear. On the basis of these factors, the Commission concluded that the continued issuance of the Amateur Extra Class license as part of the incentive licensing proposal was appropriate and warranted.

Exclusive frequencies

In the original proposal, the Commission, as an incentive for the upgrading of licenses, proposed the reservation of frequency segments in the 2, 6, 15, 20, 40 and 80 meter bands for the exclusive use of the higher class licensees. In a majority of comments exclusive frequency privileges were endorsed as the most meaningful incentive which could be offered to the amateurs. They also favored the reservation of those frequencies which are most attractive and useful to the licensee.

An important exception pertained to the fact that there was no provision in the original proposal for any exclusive radio-telephone segments for holders of the Amateur Extra Class license. It was felt that this resulted in a total lack of incentive for amateurs who are primarily interested in radiotelephony to advance to this license class.

The Commission concluded that the proposal for the reservation of frequency segments for the exclusive use of higher-class licensees as the incentive for license upgrading should be adopted. It was further determined that the Amateur Extra Class li-

censees would be, in addition to the exclusive CW segments originally proposed, exclusively entitled to operate in the radiotelephone segments 3800 to 3825 kHz and 21250 to 21275 kHz.

A time schedule was adopted which provides that the reservation of about one half of the exclusive band segments will be implemented on November 22, 1968, and the other half on November 22, 1969. Notwithstanding this schedule, the Commission intends a careful review, and if it is determined that there is insufficient occupancy of any part of the reserved frequency segments, then the effective date of the time schedule will be stayed in whole or in part, whichever is appropriate.

A small number of comments recommended a power reduction for lower-class licensees with maximum authorized power reserved for the higher classes. This was not regarded as feasible by the Commission for several reasons. First of all is the likelihood that power limitations would present numerous enforcement difficulties. Also, the Commission noted that since a great many amateurs do not need or utilize maximum power, power limitations are not particularly meaningful, at least to these licensees, and therefore, would not provide the desired incentive.

In the proposal contained in Docket 15928, 144 to 145 MHz was also proposed as an exclusive frequency segment for higher-class licensees. Many amateurs maintained that since this band is very useful for experimental operation, it should continue to be available to all licensees. The Commission agreed with these comments, and therefore, deleted the proposed 144 to 145 MHz reservation from the adopted regulations.

Distinctive call signs

It was originally proposed that amateurs would be assigned distinctive call signs to denote the licensee's operating privileges. The primary purpose of the distinctive call signs was to enable the Commission's monitoring personnel to readily determine whether individual amateurs were operating within the range of their privileges.

A very large percentage of the amateurs who sent in comments objected strenuously—usually because they had become both attached and widely associated with their call signs. As one comment noted, "Most amateur radio operators regard their call signs as next

to importance to their names . . ."

The FCC is sympathetic to the importance which most amateurs attach to their present call signs. In as much as most of the present call signs would be changed to some extent, they re-examined the basis for this proposal. They have concluded that there are two factors which will serve the effective administration and enforcement of the Amateur Radio Service without the distinctive call signs, at least at this time.

First, they feel that they can rely upon most amateurs to operate within the limits of prescribed authority and to largely regulate their own radio service. Second, automatic data processing equipment now makes listings of amateurs available which show their operating class. In fact, this has already been included in the latest edition of the *Radio Amateur Callbook*. With this information readily available to monitoring personnel for prompt identification purposes, enforcement requirements remain minimal. With these factors in mind, the Commission decided not to adopt the proposal for distinctive call signs at this time.

From the wording of the proceeding, it is apparent that the Commission is not adopting the distinctive call signs now, but they're leaving the door open. If the amateurs do not continue to police themselves, and enforcement of the exclusive frequency segments becomes a problem, they will probably take a closer look at distinctive call signs.

Two-letter calls

One aspect of the proposed call sign schedule included the assignment of two-letter calls to Extra Class licensees. At the present time there are approximately 8,000 of these calls available for assignment. Therefore, to reflect longevity and/or attainment in amateur licensing, these calls, in addition to being available to previous holders of two-letter calls, will also be assigned to Amateur Extra Class licensees who submit proof that they held an amateur radio operator's license issued by the United States Government 25 years or more prior to the date of application. The \$20.00 special call sign request fee will be applicable to these requests, but applicants will not be permitted to select specific two-letter calls. And, new holders of these call signs will be limited to one such assignment since there are so few available.

Present holders of two-letter call signs can continue to hold them even if they do not meet the criteria noted above. Also, former holders of a specific two-letter call sign may regain that call if it is available in accordance with Section 97.51 (a) (1) and (2) of the regulations.

Novice Class

The Commission proposed that new holders of the Novice Class license would be given a two-year non-renewable license in place of the present one-year non-renewable term. They also proposed that the Novice radiotelephone privileges in the frequency segment 145 to 147 MHz be deleted.

The extension of the Novice Class term was intended to afford these licensees additional time for developing their proficiency and knowledge before attempting to advance to a higher class. Also, deletion of radio-telephone privileges was designed to foster their code proficiency. It has been proven that all too often the Novice spends too much of his term on phone, and when his license expires, he is not able to qualify for the General ticket.

The FCC reports that almost without exception the comments on the two Novice proposals supported them. Since the Commission felt that the considerations which prompted these proposals remain valid, they were both adopted.

Conditional Class

The Commission also proposed that the Conditional Class license would no longer be available to new applicants who claim eligibility solely by virtue of active duty in the armed forces. However, with the recent increases in the armed forces, they felt that the adoption of this proposal could adversely affect many people on active duty. Therefore, they decided not to adopt this proposal at the present time.

Summary

We have been waiting a long time for the outcome of the incentive licensing proposal, and the new regulations which go into effect on November 22, 1967, are more than fair. None of the exclusive band segments go into effect until November 22, 1968, so there is more than adequate time for everyone interested to qualify for a higher class license.

If you're primarily interested in operating on the phone bands, and presently hold a General Class license, all you have to do is pass the advanced technical test-there are no additional code speed requirements. The Advanced Class license that you obtain will give you all but two 25 kHz phone assignments-one on 80, the other on 15.

If you're interested in operating CW, the lower 25 kHz (lower 50 kHz in two years) of the bands are available when you qualify for the Amateur Extra Class. If you are primarily a CW operator, the 20 words per minute shouldn't be too much of a problem. The more advanced technical test might be a challenge, but with a little book work this shouldn't be too tough either.

The amateur who is going to have to work the hardest is the phone man who wants to operate on the two exclusive 25 kHz Amateur Extra phone bands on eighty and fifteen meters. His code may be a little rusty, but with some concentrated effort it is possible. And, it is a small price to pay for full operating privileges.

I must agree with the FCC when in concluding they said, "In reaching its conclusions, the Commission has made every reasonable effort to provide an opportunity for the remodeling and revitalization of the Amateur Radio Service without changing its basic character and spirit and without depriving any amateur licensee of the major portion of his present operating privileges. It remains only for the licensee to prove himself and to improve the Amateur Radio Service by voluntarily upgrading his license to the highest level of achievement of which he is capable. We are confident that we can rely upon the amateurs in this regard, and that, therefore, this incentive licensing program will result in a radio service which will be a source of pride to both amateur licensees and the Commission.

Get the books off the shelf, listen to the code practice sessions on W1AW and let's get with it. Right now you have a year to prepare; don't wait until it is too late. We'll try to help you as much as we can-watch for a big technical series designed for the Advanced and Amateur Extra Class license examinations starting next month in 73. We can't help you with your code speed-all that takes is practice. But don't wait too longstart right now.

. . . W1DTY

Part 97 of the Commission's Rules is amended as follows:

97.7 Privileges of the operators licenses

(a) Amateur Extra Class and Advanced Class. All Authorized amateur privileges including exclusive frequency operating authority in accordance with the following table (see Table 1), effective on the dates shown.

(b) General Class and Conditional Class. All authorized amateur privileges except those exclusive frequency operating privileges which are reserved for the Advanced Class and/or the Amateur Extra Class.

(c) Technician Class. All authorized amateur privileges on the frequencies 50.25-54 MHz and 145-147 MHz and in the amateur frequency bands above 220 MHz.

Note: Technician class licensees may additionally operate on the frequencies 50-50.25 MHz until November 22, 1968, and 50.1-50.25 MHz November 22, 1969.

(d) Novice Class. Those amateur privileges designated and limited as follows:

(1) The dc plate power input to the vacuum tube or tubes supplying power to the antenna shall not exceed 75 watts, and the transmitter shall be crystal controlled ·

(2) Operation on the frequency bands 3700-3750 kHz, 7150-7200 kHz, 21.10 to 21.25 MHz, and 145-147 MHz is authorized for radio-telegraphy using only type A-1 emission.

Note: Novice Class licensees may additionally operate until November 22, 1968, on 145-147 MHz for radiotelephony using types of emission as set forth in 97.61.

Section 97.9(b) is amended to read as follows: 97.9 Eligibility for new operator license.

(b) Advanced Class. Any citizen or national of the United States.

Section 97.21 is amended to read as follows: 97.21 Examination elements.

Examinations for amateur operator privileges will comprise one or more of the following examination elements:

(a) Element 1(A): Beginners' code test at five (5) words per minute;

(b) Element 1(B); General code test at thirteen

(13) words per minute;(c) Element 1(C): Experts' code test at twenty (20) words per minute;

(d) Element 2: Basic law comprising rules and regulations essential to beginners' operation, including sufficient elementary radio theory for the understanding of those rules:

(e) Element 3: General amateur practice and regulations involving radio operation and apparatus and provisions of treaties, statutes, and rules affecting

amateur stations and operators;
(f) Element 4(A): Intermediate amateur practice involving intermediate level radio theory and operation as applicable to modern amateur techniques, including, but not limited to, radiotelephony and radiotelegraphy;

(g) Element 4(B): Advanced amateur practice involving advanced radio theory and operation as applicable to modern amateur techniques, including, but not limited to, radiotelephony, radiotelegraphy, and transmissions of energy for measurements and observations applied to propagation, for the radio control of remote objects and for similar experimental

Section 97.23 is amended to read as follows: 97.32 Examination requirements.

Applicants for original licenses will be required to pass the following examination elements:

(a) Amateur Extra Class: Elements 1(C), 3, 4(A), and 4(B):

- (b) Advanced Class: Elements 1(B), 3, and 4(A);
- (c) General Class and Conditional Class: Elements 1(B) and 3;
 - (d) Technician Class: Elements 1(A) and 3;
- (e) Novice Class: Elements 1(A) and 2. Section 97.25(c) is amended to read as follows: 97.25 Examination credit.
- (c) An applicant for the Amateur Extra Class operator license will be given credit for examination elements 1(C), 4(A), and 4(B), if he so requests and submits evidence of having held a valid amateur radio station or operator license issued by an agency of the United States Government during or prior to April 1917, and qualifies for or currently holds a valid amateur operator license of the General or Advanced Class.

(a) The examination for Amateur Extra, Advanced, and General class of amateur operator licenses will be conducted by an authorized Commission employee or representative at locations and at times specified by the Commission.

Section 97.31(b) is amended to read as follows: 97.31 Grading of examinations.

(b) Seventy-four percent (74%) is the passing grade for written examinations. For the purpose of grading, each element required in qualifying for a particular license will be considered as a separate examination. All written examinations will be graded only by Commission personnel.

Section 97.33 is amended to read as follows: 97.33 Eligibility for re-examination.

An applicant who fails an examination for an amateur operator license may not take another examination for the same or higher class amateur

operator license within 30 days, except that this limitation shall not apply to an examination for an Advanced or General Class license following an examination conducted by a volunteer examiner for a Novice, Technician, or Conditional Class license. Section 97.51(a) (5) is amended to read as follows: Assignment of call signs.

(5) One unassigned two-letter tall sign (a call sign having two letters following the numberal) may be assigned to a previous holder of a two-letter call sign the prefix of which consisted of not more than a single letter. Additionally, a two-letter call sign may be assigned to an Amateur Extra Class licensee who first held an amateur radio operator license issued by the Commission, or by one of its predecessor agencies, 25 years or more prior to the receipt date of an application for such assignment. Applicants for two-letter call signs are not permitted to select a specific assignment except in accordance with subparagraphs (1) and (2) of this paragraph.

97.59 License term.

(a) Amateur operator licenses are normally valid for a period of 5 years from the date of issuance of a new or renewed license, except the Novice class which is normally valid for a period of 2 years from the date of issuance.

(b) The license for an amateur station is normally valid for a period of 5 years from the date of issuance of a new or renewed license except that an amateur station license issued to the holder of a Novice Class amateur operator license is normally valid for a period of 2 years from the date of issuance.

	PHONE ALLOCATION			CW ALLOCATION	
	Extra Class	Advanced Class	General Class	Extra Class	Advanced and General Class
Current	3.8 - 4.0 7.2 - 7.3 14.2 - 14.35 21.25 - 21.45 28.5 - 29.7 50.1 - 54.0	3.8 - 4.0 7.2 - 7.3 14.2 - 14.35 21.25 - 21.45 28.5 - 29.7 50.1 - 54.0	3.8 - 4.0 7.2 - 7.3 14.2 - 14.35 21.25 - 21.45 28.5 - 29.7 50.1 - 54.0	3.5 - 4.0 7.0 - 7.3 14.0 - 14.35 21.0 - 21.45 28.0 - 29.7 50.0 - 54.0	3.5 - 4.0 7.0 - 7.3 14.0 - 14.35 21.0 - 21.45 28.0 - 29.7 50.0 - 54.0
November 22, 1968	3.8 - 4.0 7.2 - 7.3 14.2 - 14.35 21.25 - 21.45 28.5 - 29.7 50.1 - 54.0	3.825-4.0 7.2 - 7.3 14.2 - 14.35 21.275-21.45 28.5 - 29.7 50.1 - 54.0	3.85 - 4.0 7.225 - 7.3 14.235 - 14.350 21.3 - 21.45 28.5 - 29.7 50.1 - 54.0	3.5 - 4.0 7.0 - 7.3 14.0 - 14.35 21.0 - 21.45 28.0 - 29.7 50.0 - 54.0	3.525 - 4.0 7.025 - 7.3 14.025 - 14.35 21.025 - 21.45 28.0 - 29.7 50.0 - 54.0 (A) 50.1 - 54.0 (G)
November 22, 1969	3.8 - 4.0 7.2 - 7.3 14.2 - 14.35 21.25 - 21.45 28.5 - 29.7 50.1 - 54.0	3.825- 4.0 7.2 - 7.3 14.2 - 14.35 21.275- 21.45 28.5 - 29.7 50.1 - 54.0	3.9 - 4.0 7.25 - 7.3 14.275 - 14.35 21.35 - 21.45 28.5 - 29.7 50.25 - 54.0	3.5 - 4.0 7.0 - 7.3 14.0 - 14.35 21.0 - 21.45 28.0 - 29.7 50.0 - 54.0	3.55 - 4.0 7.05 - 7.3 14.05 - 14.35 21.05 - 21.45 28.0 - 29.7 50.0 - 54.0 (A) 50.25 - 54.0 (G)

- 1. The only change in Technician Class privileges occurs in the 50-MHz band. Until November 22, 1968, the Technician Class licensee is authorized all 6-meter privileges from 50.0 to 54.0 MHz. He may operate on the frequencies 50.1 to 54.0 MHz after November 22, 1968, and on the frequencies 50.25 to 54.0 MHz after November 22, 1969.
- 2. Novice Class licensees are authorized radio-telegraphy operation on 3700-3750 kHz, 7150-7200 kHz, 21.10-21.25 MHz and 145-147 MHz using only A-1 emission. Additionally, Novice Class licensees may operate radiotelephone on 145-147 MHz until November 22, 1968.

More than 5 million two-way transmitters have skyrocketed the demand for service men and field, system, and R & D engineers. Topnotch licensed experts can earn \$12,000 a year or more. You can be your own boss, build your own company. And you don't need a college education to break in.

How WOULD YOU LIKE to earn \$5 to \$7 an hour...\$200 to \$300 a week ...\$10,000 to \$15,000 a year? One of your best chances today, especially if you don't have a college education, is in the field of two-way radio.

Two-way radio is booming. Today there are more than five million two-way transmitters for police cars, fire trucks, taxis, planes, etc. and Citizen's Band uses—and the number is growing at the rate of 80,000 new transmitters per month

This wildfire boom presents a solid gold opportunity for trained two-way radio service experts. Most of them are earning \$5,000 to \$10,000 a year more than the average radio-TV repair man.

Why You'll Earn Top Pay

One reason is that the U.S. doesn't permit anyone to service two-way radio systems unless he is *licensed* by the FCC (Federal Communications Commission). And there aren't enough licensed experts to go around.

Another reason two-way radio men earn so much more than radio-TV service men is that they are needed more often and more desperately. A two-way radio user must keep those transmitters operating at all times, and must have them checked at regular intervals by licensed personnel to meet FCC requirements.

This means that the available li-

censed expert can "write his own ticket" when it comes to earnings. Some work by the hour and usually charge at least \$5.00 per hour, \$7.50 on evenings and Sundays, plus travel expenses. Others charge each customer a monthly retainer fee, such as \$20 a month for a base station and \$7.50 for each mobile station. A survey showed that one man can easily maintain at least 15 base stations and 85 mobiles. This would add up to at least \$12,000 a year.

How to Get Started

How do you break into the ranks of the big-money earners in two-way radio? This is probably the best way: 1. Without quitting your present job, learn enough about electronics fundamentals to pass the Government FCC License. Then get a job in a two-way radio service shop and "learn the ropes" of the business.

2. As soon as you've earned a reputation as an expert, there are several ways you can go. You can move out, and start signing up your own customers. You might become a franchised service representative of a big manufacturer and then start getting into two-way radio sales, where one sales contract might net you \$5,000. Or you may be invited to move up into a high-prestige salaried job with one of the same manufacturers.

The first step—mastering the fundamentals of Electronics in your spare time and getting your FCC License—can be easier than you think.

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everything clear and easy, even for men who thought they were "poor learners." You'll learn not only the fundamentals that apply to all electronics design and servicing, but also the specific procedures for installing, troubleshooting, and maintaining twoway mobile equipment.

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How to get into one of today's hottest money-making fields—servicing 2-way radios!



He's flying high. Before he got his CIE training and FCC License, Ed Dulaney's only professional skill was as a commercial pilot engaged in crop dusting. Today he has his own two-way radio company, with seven full-time employees. "I am much better off financially, and really enjoy my work," he says. "I found my electronics lessons thorough and easy to understand. The CIE course was the best investment I ever made."



Business is booming. August Gibbemeyer was in radio-TV repair work before studying with CIE. Now, he says, "we are in the marine and two-way radio business. Our trade has grown by leaps and bounds."

Feeding the Cat Underwater

Underwater Radio

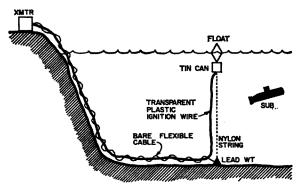
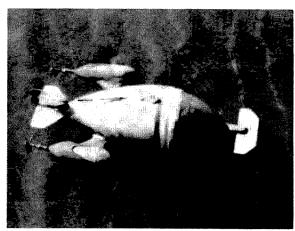


Fig. 1. Vertically polarized underwater antenna used by K6BIJ for controlling a radio-controlled submarine below the surface. Good results were obtained in tests from dc to 4 MHz.

It all started when I went to a lake in San Francisco's Golden Gate Park, to take some movies of radio controlled model boats. In talking to the people who were operating these boats, I learned they knew of no radio-controlled submarine built as yet, which could be controlled while completely submerged. A search of RC magazines, both in this country and in England, revealed



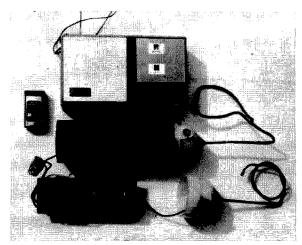
Radio-controlled submarine used by K6BIJ in his underwater radio propagation tests.

only brief mention of a couple of subs which lost control the moment their antennas touched the water.

By investigating the subject a little further, it was learned that the Navy is talking to its subs while they are submerged, using Morse code on a low frequency around 18 kHz. They are using lots of power to get through. The subs, presumably, only sit up and listen. The higher frequencies are considered useless for this purpose, as water "short circuits" them or something.

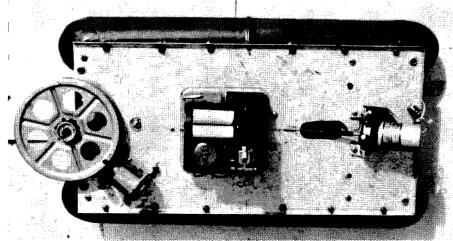
I was unable to determine who made this brilliant conclusion, or what his test setup was, but I think he goofed. Most probably, he was unable to couple the output of his transmitter to the water, and lost everything at the water/antenna junction.

A little waterproof transmitter was built with a modulated output of one miliwatt which was crystal controlled on 4 MHz. It's output was coupled to an "antenna"



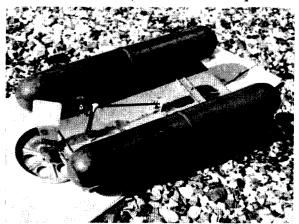
The I-milliwatt, 4 MHz transmitter used by K6BIJ in his underwater propagation tests. The receiver is a Japanese transistor model that covers the marine band up through 4 MHz.

Top view of the underwater-radio-controlled catamaran showing the 10V Ni-Cad toothbrush battery and control devices.



consisting of two pieces of heavy copper braid, about a foot long on each side of the transmitter. This contraption was "drowned" 30 feet off shore, in a lake about 5 feet deep. It rested about a foot off the bottom. The receiver was a Japanese transistor radio with a "marine band" which extended to 4 MHz and had no rf stage. The antenna was about 20 feet of bare wire which was submerged, except for the middle where it made a single turn around the receiver. When I turned the receiver on, the signal was there, but it was a maximum distance. This test was repeated with an 8.5 MHz crystal with about the same results.

At this point, I felt a need to build a radio-controlled submarine. I constructed one using two Clorox bottles, glued back to back. I used N-Cad batteries with a car heater motor for the propeller, and a smaller motor for the rudder. Various receivers were used in the "brain", and various frequencies



Bottom view of the beached radio-controlled catamaran showing the drive propeller and motorized rudder control. This "cat" could be completely controlled by a radio transmitter and antenna mounted beneath the surface of the water.

were tested from dc to 4 MHz.

A surface boat (catamaran) was built. The cat was fed an underwater signal which was picked up about a foot below the hull from a little lead ball suspended on a flexible cable which was insulated for three quarters of it's length by plastic tubing.

With this set-up, it was possible to determine that:

- 1. A quarter watt was sufficient output from the transmitter to give the sub, or the catamaran, a range of about 60 feet.
- 2. Frequencies in the shortwave range do go through the water, and can be used for remote control, teletype, telemetry, voice, and TV communications. The range can be up to a few miles with good equipment.
- 3. Propagation takes the form of a familiar picture of magnetic filings on a piece of

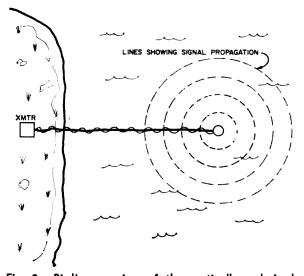


Fig. 2. Bird's eye view of the vertically polarized antenna shown in Fig. 1, showing the wavefront of a propagating signal.

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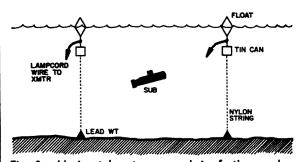


Fig. 3. Horizontal antenna used in further underwater radio control tests. The propagation from this antenna is shown in Fig. 4.

paper with a bar magnet underneath.

- 4. Field strength (or usable control distance) increases significantly with increase in transmitter power. The depth of water, shoreline configuration, presence of buried pipes or cables, and soil material can affect this increase.
- 5. The signal can be either horizontally or vertically polarized. Horozontal polarization was used for a shallow lake and the sub, while the cat's antenna was vertically polarized.

The lake was a fresh water lake with a fairly high salt content, so the results may differ a little in a pure fresh water situation, or in sea water.

It is my opinion that, with a little development, services like LORAN can be moved underwater where there would be no static or night effect. This might give the hams the 160-meter band back again. With further experiments, it is possible that we will find that water transmits radio signals better than air.

. . . **K6**BII

DEAD

DEAD

DEAD

AREA

AREA

LAMPCORD TO TIN CANS

Fig. 4. Underwater propagation of radio signals from the horizontal antenna shown in Fig. 3.

Mobile Antennas for the Non-Mobileer

Some simple but effective ring antennas which may be temporarily mounted on an automobile for operation on 20 to 6 meters. They are especially suitable for portable operation.

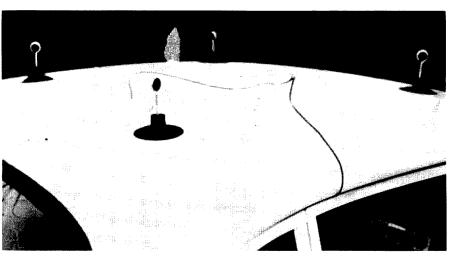
I have never cared for in-motion mobile operation but I have often wished, when on vacation or parked on a hillside, that I could operate what might be called, without getting into legal semantics, portable/mobile. That is, from my automobile while it was stationary. I certainly didn't want to start drilling holes in the car for a regular mobile antenna just for this occasional usage. Nor could I depend upon always having some natural support for a random length antenna near where I was parked.

Ring-type radiators appeared to be the answer because they could be mounted directly on the roof of the car (the most efficient location as far as achieving a uniform radiation pattern), and their size would permit at least a 20-meter antenna without loading elements even on a compact-car roof. Ring-type radiators, or Hula-Hoop antennas, are commonly of either ¼ or ½ λ size, as shown in Fig. 1. The ¼ ring or DDRR antenna has an omnidirectional radiation pattern, vertically polarized. Its height above

ground should be at least .007 to .010 λ . The closer its proximity to ground, the sharper will be its resonance. At about .010 λ elevation, it can be represented by a tuned circuit with a Q of about 100 to 200. This bandwidth is certainly sufficient for operation over the phone band on 20 and 15 meters and for about any selected 300 kHz portion on 10 meters. The $\frac{1}{2}\lambda$ ring or dipole is a lower-Q radiator and omnidirectional when elevated from ground heights comparable to ½ λ dipole. Its polarization under these conditions is horizontal. However, when placed in close proximity to ground, its resonance becomes much sharper and, like a ½ λ dipole off of its ends, it seems to exhibit predominantly vertically-polarized radiation.

My first thought was to construct such antennas from tubing, in the form of squares, so they could be self-supporting and simply placed on the car roof as desired. Such a method of construction was deemed too expensive but it might be well considered by anyone who would want to have such an

A square six-meter ring radiator mounted on the roof of a compact car. The "extra" piece of wire from the feed point is a tuning stub.



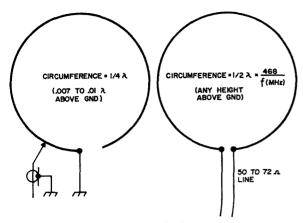


Fig. 1. Basic dimensions of the one-quarter wave and one-half wave ring radiators used for fixed/portable operation by WIDCG.

antenna semi-permanently mounted. A cartop carrier rack can make an excellent foundation for such an installation since it provides a mounting base as well as tubing which can be supported by standoff insulators and used as the antenna elements.

The method I arrived at for construction was considerably simpler and is shown in the photograph. TV standoff insulators were inserted into rubber suction cups for use as support elements for a "square" wire ring. The insulators were secured in the suction cups by small wooden pegs and epoxy cement. The suction cups themselves are replacement types for use with car-top carrier racks and can be obtained very inexpensively at almost any automobile supply store.

The wire ring is made from normal hookup wire. The feed system used for the antennas is shown in Fig. 2. I used 72-ohm twinlead because I had it available, and it permitted easy passage through the car door. Coaxial cable could be used equally as well, although it will sag the loop at the feed point unless a separate suction cup/insulator is used to support it. The extra length of transmission line shown in the photograph of the 6-meter $\frac{1}{2}\lambda$ ring is a tuning stub used to improve the match between the antenna and transmission line. It may not be necessary in all installations depending up the reactive portion of the antenna feed point impedance but, in any case, its fairly easy to adjust. An approximate ½ λ stub is used and trimmed about 1/2-inch at a time until the SWR is as close as possible to 1:1. If the SWR without the stub already measures 1.5 to 1 or less, the stub can be forgotten.

When using a ¼-wave ring antenna, a gamma match is used for matching. The

spacing shown in Fig. 2 can be taken as about $1/40~\lambda$ to start and then adjusted back and forth for the lowest SWR. It should be possible to obtain an SWR of at least 1.5 to 1 or less. The grounding of the one end of the antenna should be done with a jumper of Belden braid or similar material to a small "C" clamp or other binding post on the rain gutter. A proper ground is very essential to the efficient performance of this antenna and the rain gutter connection should be as low a resistance connection as possible.

As long as the antenna is set up on the car roof in the same position each time it is used, there will be no need to change the stub length or feed point spacing. The efficiency of these antennas-both the 1/4 and the ½ λ loop—has never been definitely determined. Most experimental studies have placed them as being from 6 to 10 dB below the performance of a 1/4 \(\lambda\) whip above a flat conducting surface. I tried to compare the performance of a 15-meter ¼ λ ring radiator to that of a $\frac{1}{4}$ λ whip mounted in the middle of the car roof. However, since I wasn't willing to make a ground connection immediately at the base of the whip by drilling into the car roof, I made it to the rain gutter of the automobile. The effect of this 2 foot or so ground loop probably reduced the effectiveness of the whip somewhat. On local contacts the ¼ \(\lambda\) ring radiator proved to be from 2 to 3 "S" units lower in performance than the ¼ \(\lambda \) whip. However, it must be remembered that this performance was measured against a full-size ¼ λ whip and not a loaded whip. Therefore, on 20-meters, although the performance of the $\frac{1}{4}$ λ ring radiator might well be a few "S" units below that of a full-size $\frac{1}{4}\lambda$ whip, it would be equal to or even exceed that of the normal

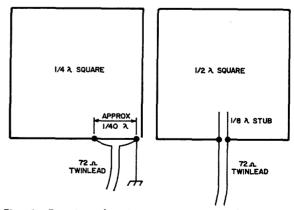


Fig. 2. Forming the rings into squares distorts the horizontal radiation pattern somewhat, but the antenna is still essentially omnidirectional.



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8-foot center or base-loaded whip.

The ring-type radiators can also be used in other "portable" type installations. In the case of the ¼ \(\lambda\) loop some flat, metallic surface is required as the ground plane. A sheet metal type of roof, for instance, might suffice as long as the metal sheets were electronically bonded together. The ½ λ loop does not require a ground plane and can be mounted in any space of sufficient size—as, for example, an attic. The vertical radiation pattern of such an antenna will essentially be that of a dipole mounted a similar height above ground. Therefore, heights of ½ \(\lambda\) or more above ground are best when the antenna is to perform as a horizontally-polarized omnidirectional radiator.

... W1DCG



"Who needs miniaturization?"

Battery Holder

You can construct a holder to accommodate popular 9-volt batteries by modifying a twin AA holder. With a pair of pliers, break off the outside prongs of the holder's U-shaped clips to make room for the larger battery. Then bend the outside prongs inward so they have a snug hold on the battery. When inserting the battery in the holder, be careful not to short the terminals against the frame of the holder.

. . . Ray Ezelle WPE8JJQ

R. L. Gunther W6THN/VK7RG 76 View Street Hobart, Tasmania, Australia

Why Abuse Semiconductors?

Having trouble with blown transistors and dead junctions? No need to if you understand their limits and capabilities and follow a few simple rules.

What they do

As everyone knows, diodes rectify, transistors amplify, and a great number of other types of other semiconductors do a lot of other things. But they all semiconduct, and semiconductors can be abused more easily than tubes. There is no mystery in this (or at least not much), and a few simple procedures can save you a lot of trouble and money.

Consider diodes1. They conduct more easily in one direction than the other, as indicated by the typical curves of Fig. 1. The current axis are in different units, because a lot more current can be passed without damage in the forward direction than in reverse. By knowing the shape of these curves you can test diodes for yourself, simply by applying a variable voltage to them, and watching how the current behaves; but be sure to use a suitable resistance in series with the diode (Fig. 3) to limit the current, because the characteristic quickly becomes violent, and excessive current could be passed by a power source with low resistance. To test the forward current rating, apply some current, and see how hot the diode gets, then apply some more after a little while. A practical maximum current would be the value for which a silicon diode gets uncomfortably hot to the touch, or for which a germanium diode gets quite warm; this assumes that the appropriate heat sink, if any, is fitted.

To test the reverse voltage rating, apply voltage (again with series limiting resistance) until the reverse current through the diode starts to rise sharply. The voltage across the diode is then the absolute maximum value which can be applied safely to it. For this test, you should not put more than about 20 microamperes through a low current (eg., up to 1-amp forward rating) silicon diode, perhaps 500 microamperes through a highcurrent silicon diode, or 200 microamperes through a germanium diode. The actual maximum safe value will depend, to a certain extent, on the type of diode, and will generally be higher for lower PIV diodes. While learning how to do this you may ruin a diode now and then, but it is worth it in the long run.

The situation with transistors is rather more complicated, and I earnestly recommend that you read Chapter 2 in the Motorola Power Transistor Manual, and Chapter 1 in the latest edition of the GE Transistor Manual; both of these excellent works should be on everyone's bookshelves. Basically, however, the transistor behaves as two diodes hooked back-to-back. Taken individually, the junctions can be tested as two separate diodes, but the complications arise when a

transistor is considered all together, as it is normally used.

Interpretation of the results of testing different types of diodes can be clarified by reference to Fig. 2, which is shown rightside-up for convenience. Curve 1 is the typical response of a zener diode, curve 2 is for a typical silicon diode, and curve 3 is the behavior of a germanium diode. In each case the current rises alarmingly above the absolute maximum PIV. This is the important fact in considering how far you can push a semiconductor. In most circuits, the source impedance is low, so that even a slight voltage overload will push the current right up the curve past the danger point, and the semiconductor will be ruined (usually by shorting). In testing the devices, the trick is to provide that resistor in series, so that you can approach the critical point slowly enough to see what is happening, without danger.

What they will not do

Those of us who are familiar with the operation of tubes find it hard to take this "absolute maximum" thing seriously. We are well familiar with the fact that it is possible to abuse the current and voltage ratings of a tube considerably, with scant regard for the manufacturer's specifications. On the other hand, we do tend to be more cautious about mercury vapor rectifiers, because their PIV is indeed critical. The fact is that nearly all semiconductors fall in this latter category, and you ignore it at your peril. Apparent exceptions to this rule are illusions, as I shall show here.

Instabilities Confirm Abused Semiconductors

Recently in the Australian literature I saw a reference to "ICAS" (Intermittent Commercial and Amateur Service) ratings as applied to the use of silicon diodes in power supplies. This is dead wrong, and is a common worldwide misconception.

If you use a BY100 (or IN4006) with a 1000V peak supply, and feel pleased with yourself because it is theoretically rated for only "800V", look again, and test the actual PIV of the diode². You will find that it will test for an absolute maximum peak of 1400V or better, so there is no mystery. The manufacturer has, as usual, merely rated them pessimistically. Come to think of it, I had better qualify that "as usual" slightly for

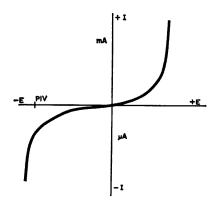


Fig. 1. Typical diode characteristics. Note that the current scales above and below the voltage axis are in different units.

American readers. The ratings of American semiconductors may or may not be optimistic. Commercial items will certainly be as good or better than the catalogue says, but you cannot trust surplus or bargain items at all. In regard to the latter, you will find that a diode rated at, say, 400 PIV, may actually be anything from 0 PIV to 1000 PIV when you measure it. If you depend on it being the theoretical value, you may be in strife when you go to use it. This situation tends to be worse for the "better bargains", but I hasten to add that there are several reasonably reliable distributors of inexpensive semiconductors. But you never want to make the mistake of taking their word for any ratings.

The same thing applies to transistors (and probably to FETs, etc.). The lowly OC26 (similar to HEP-230) is rated for something like 32V for BVcbo (breakdown voltage from collector to base, when emitter not connected, i.e., open). I have yet to find one that tested less than 50V, and many up around 100V (whether this applies to the equivalent 2N301 is something you should determine for yourself). If a person did not know this, he might assume that he was getting away with something by using the transistor over its published rating. Nor is it safe to make the opposite assumption that since the manufacturer tends to overrate his semiconductor, you can get away with overloading it; because you don't know how far that can be carried. So we warned: there is no magic about semiconductors (compared to tubes), only mean and relatively inflexible Absolute Maximum characteristics which can not be exceeded under ordinary operating conditions. This stricture has special importance in the matter of the voltage rating of transistors used as class-C rf amplifiers, but that will be the subject of another article, sometime.

One among many typical examples of "ICAS" thinking is found in the otherwise excellent article on a new method for adjusting grid bias to economize on drive in class-C rf amplifiers in the RSGB Bulletin for March 1967, p. 143. A transistor is used to adjust grid bias according to rf drive available, and the statement is made: "The maximum collector-to-base rating of the OC28 is 80 volts at zero current, whereas the actual bias used in this instance happens to be 75 volts. This seems rather a fine margin, but currents are small, and no trouble has been experienced. However, the higher rated OC20 or OC36 would be preferable, and for those who find higher values of standing bias necessary there are a number of transistors available having considerably higher ratings . . . " There are indeed, but they may have "OC28" stamped on them. Now, in the circuit involved in this article, there is a base-emitter resistance of something like 5k ohms. The BV cos (voltage rating collector to emitter with base shorted to emitter) rating of a transistor is about the same as BV_{cbo}, but as the base-emitter resistance increases, BV_{ee} decreases until, with the base floating ("open") it decreases to BV_{ceo}. BV_{ceo} can be anything from 40% to 80% of BV_{ces}, so the useful voltage rating of a transistor depends quite a lot on the amount of resistance in its base circuit. The rating with a given value of resistance can be called BVcer. Now, with 5k in the base of the OC28 transistor, the BV err is certain to have dropped, say 20% at least, from its BVebo value. In this example the BV cer could have been about 65V if you take the manufacturer's word for it. This is plainly inadequate

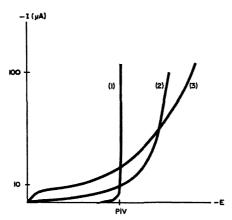


Fig. 2. The reversed-biased characteristics of zener diodes (1), silicon diodes (2) and germanium diodes (3). Note that this drawing is shown upside down from the usual presentation.

for a circuit applying 75V from collector to emitter. No, the obvious fact here is that the actual rating of the OC28 used was appreciably higher, a fact which can be ascertained by testing it. If it is tested, the transistor can be used up to a known high voltage, with greater economy and reliability. Why not? In this particular case, where the voltage applied is essentially dc, one can approach fairly close to the transistor's maximum ratings than in a circuit with ac and a source of transients from inductance.

When to derate

After you have tested a semiconductor for actual voltage rating there is, unfortunately, another factor to consider. Unless your testing equipment is rather more elaborate than usual, you will have tested the reverse voltage rating with zero current applied in the forward direction. But when a diode (or transistor) is used in an actual circuit, there is likely to be a fair amount of forward current as well. This will heat the semiconductor, and will raise the leakage current for any given value of reverse voltage. This means that the reverse voltage must be reduced, to keep the leakage within safe limits. This is called "derating". If you apply maximum reverse voltage you have to derate forward current. If you apply maximum forward current you have to derate reverse voltage; you can't have both. If maximum rated forward current is applied, the voltage derating may be as much as 75%, and should be applied as a "safety factor". When a manufacturer (e.g. Fairchild) has specified the BV_{LVO}, a good safety factor is supplied in a circuit without inductance if the supply voltage is not more than half of this rating. The BV_{Lvo} is uniquely applicable to silicon diffused transistors, and is the value of BV eeo you obtain when Vee goes through a minimum as I. is increased through the range of 5-10 mA or so for low power transistors (but do not increase Ice appreciably once the minimum is found). If you don't know this voltage breakdown value, a rough approximation could be to assume an absolute maximum BVce about one-fourth of BVcbo when the transistor is drawing about one-half maximum collector current. For more accurate figures you must obtain the manufacturer's curves, or (better), measure them yourself. In general, it is desirable not to try to push too much collector current through any single rf transistor, not only because BV. is higher at lower I., but also because fr is too; fr actually passes through a maximum at a fairly low collector current.

When a semiconductor (particularly silicon, see Fig. 2) is operated with an inductive source or load, additional safety factor must be considered because of the energy stored in the inductance. At best it can double the voltage applied to the collector, if maximum signal output is obtained, and at worst, an inductance can supply a horrendous back-EMF, giving a destructive transient overvoltage.

In a transistor amplifier with an inductive load, the voltage swing at the collector depends on the inductance and on its Therefore, in the case of rf power amplifiers, it is desirable to ensure that the system be kept close to resonance, and never run at full ratings without a load! Because of the sharp current discontinuities, this is particularly important in the case of class-C or overdriven class-A amplifiers. Remember too, that the peak voltage will be (at least) twice the supply voltage if maximum output is being obtained, and that this will be doubled again if collector modulated. though emitter or base modulation³ is superior in many respects to collector modulation. it faces the same problem, because of the requirement for nominally double supply voltage.

Voltage derating in power supplies

Diodes fed from a power transformer, or feeding an input choke, also have inductance problems. In these cases, the amount of voltage derating can be minimized appreciably by suppressing the circuit for transients. This can be most easily accomplished by putting a 0.01 or 0.02 µF capacitor across the primary of the transformer; do not use too large a capacitor there, or you will cause another kind of transient due to shock-excited resonance with the transformer inductance. Alternatively, a capacitor may be used directly across the diode, and this can be convenient. particularly when using diodes in series, where they ought to have capacitors across them anyhow. But this is not always a good idea, because it increases the reverse leakage current around the diode on the nonconducting half of the cycle. This could be a consideration if the load were light, as for a HV supply for an oscilloscope.

In general, the correct value capacitor to use is inversely proportional to the voltage,

no matter which position you use the capacitor in. Thus, if the peak voltage is 150V, you might use 0.01 μ F, while 1500V would require 0.001 μ F.

If the secondary voltage is too high for a diode, you would use more than one diode in series. In spite of what has been discussed about this in the literature, the safest thing is still definitely to use an equalizing resistor in parallel with each diode (see September 1965 CQ article referred to previously). The resistance should be directly proportional to the PIV rating of the diode, and this allows you to use seriesed diodes of different individual PIV ratings. If more than two diodes are used in series, it is definitely desirable to parallel each with an equalizing capacitor, keeping the relationship discussed above in mind.

If you use transient suppression of any kind, the safety factor for diode PIV should be at least 1.5 times the nominal peak voltage applied to it; more about this below. If you choose not to use any transient-suppressing capacitors, the diode's PIV safety factor should be 4 or 5 times higher than the nominal peak voltage applied to the diode. If you doubt this, look in the introduction to the RCA Transistor Manual. Another good discussion of this subject can be found in Section 8 of the Selected Semiconductor Circuits Handbook, by S. Schwartz, available either in the expensive hardback edition from Wiley or in inexpensive paperback from the U.S. Government Printing Office (\$2.25 plus postage, reference No. D7.6/2:215).

If you use a choke input filter, the choke can be a horrendous source of transient peak voltages. To get around this, you must either derate diode PIV's again, or transient-suppress the choke. The simplest and cheapest is the latter, and for most power supplies this can be done by putting a 0.1 μ F capacitor in series with 1k across the choke; for more exact values see the January 1965 article in QST.

When you use a capacitor to suppress transients, remember that the capacitor must have a voltage rating at least as great as the transient that it is trying to suppress! I have found this out the hard way, where the 240V RMS line voltage here in Australia seriously strains the capability of many 600V capacitors. It is not so bad for 115V lines, but in general, the capacitor must have a working voltage at least 2½ times higher than the nominal peak ac voltage applied to it. This

is particularly important when the capacitor is used in the high-voltage secondary circuit (or across the choke).

One more brief word should be said here about current derating. In general, the current rating of a semiconductor is not quite as critical as the voltage rating, because the current just heats up the junction, and the health of the junction tends to depend more on the average temperature. But it does so only if the heat can get out of the junction. If the peak current is so high that the junction is overheated too much in a given period of time, the junction will melt, and that is that. Therefore some attention should be given to avoiding excessive peak currents in the forward direction. For diodes this means inserting a series current-limiting resistor if the load is capacitive, and for transistors, it means avoiding excessive peaks where they might occur, e.g. in dc converters or when modulating.

For silicon diodes of 750 mA size, the peak current for 60 Hz should be limited to about 30 amps, which means at least 3.5 ohms of series resistance for every 100V peak of supply. If voltage regulation is not important, I usually double this value. The tiny glass-encapsulated silicon diodes should have about three times as much series resistance, while high current diodes should have somewhat less. If some current is passed through the diode, the series resistor can get hot, so a two to five watt rating is not inadvisable for it.

When not to derate

If you only have 400V diodes (actual rating), and want a quick and simple dc supply operating from a 12V transformer, you can obviously dispense with transient suppressing capacitors. But I have seen a fair number of circuits in the experimenters' literature where no transient suppression is used at all. It is argued that, "well, this works, and diode failures are rare." I find this kind of argument appalling, because it is sloppy engineering, because capacitors are cheap, and because a suitably designed semiconductor circuit should never fail from transient destruction of the semiconductor. You can be quite certain that the 'occasional' failure will take place just when you are about to work a VK7 on 2 meters. Nuff said.

On the other hand, there are circuits where it is not feasible to use capacitative transient suppression. For example, transistorized dc/dc converters. Capacity in the circuit degrades the waveform, and decreases conversion efficiency. This can be tolerated sometimes, sometimes not; a compromise is sometimes desirable. You should read the discussion of this subject in the appropriate chapter of the excellent Transistor Radio Handbook, published by Editors & Engineers.

Transient suppression in class-C rf amplifiers can also be a problem and indeed, in class-B audio amplifiers also. A transient suppression capacitor is likely to create more problems there than it solves. In these cases, as in the dc converters, one might use an appropriately rated zener diode. But the best solution is to attempt to avoid transients in these circuits, and in any event, to use semiconductors of the maximum economically feasible voltage rating. It is most desirable to be sure that the dc power supply for these circuits is well regulated for ac-use plenty of output filter capacity. And parasitic oscillations are to be avoided like the plague.

In a tube circuit, parasitics can be a nuisance; in a transistorized one, they can be a catastrophe. This is frequently the cause of the problems about which one reads in the literature, where transistors "unexplainably" failed even though the voltage rating was apparently high enough. And I suspect that it is the cause of the problems which were encountered when it was found necessary to use germanium rather than silicon transistors in class-C rf amplifiers (e.g., CQ, June 1966).

The fact is, however, that germanium can be more reliable in several regards, and if all other matters are equal, I should prefer to use a PADT50 rather than 2N2993. In any event, avoid spurious oscillations when possible: keep leads short, avoid output-input coupling, always neutralize rf amplifiers, and avoid undesirable combinations of RFC, etc. (e.g., ref: Radio Handbook, published by Editors & Engineers; or Principles of RF Power Amplifiers by Techpress).

What is a "nominal" voltage?

I have used the word "nominal" to describe the voltage applied to a rectifier diode. What does this mean? It means the voltage peak which is supplied by the transformer, and which does not include any extra transients. It should be a simple matter to determine the nominal peak voltage by inspection of the circuit, and of the transformer rating, but many good technicians seem to flounder on this rock.

Say your transformer secondary is 71V RMS. That means 100V peak. If you feed it into a half-wave diode with a resistive load, the nominal peak on the diode will be 100V. If, on the other hand, you use a capacitor input filter, the input capacitor will add to the transformer voltage on the off cycles, and the diode will see a 200V inverse peak! Presumably a choke input filter would be treated as a resistive load if suitable suppression were used across the choke, but I am distrustful of such things, and would rather treat it pessimistically, to assume 200V in this instance.

If the same transformer were center tapped and you used two diodes in the usual full-wave configuration, the voltage across each diode is still 100V on the off cycle, no matter whether you use capacitor or resistance load.

If the transformer is not tapped, and you use a full-wave bridge, each diode still sees 100V peak inverse, and should therefore be rated for at least 150V if transient suppression is employed.

If the same transformer is used in a voltage multiplier circuit, each diode will see 200 PIV across it, no matter whether it is a voltage doubler or tripler or whatever.

I have put all of these facts into a nice handy chart (Table 1), to be perused easily and casually, and have also spelled them out in order to emphasize the situation. If you are not already well familiar with them, do commit them to memory right away. It will pay off very well each time you design any power supply, and will remove any confusion about rules concerning how much output you get for how much input and how this is related to diode PIV. You already know how much you get out of the different configurations of power supplies, and need only to make sure about the diode ratings. If I labor this point, it is only because I have seen it abused in proper research laboratories where the participants ought to have known better.

There is no magic about these relationships, either. If you forget them, you can always figure them out simply, by drawing the circuit diagram, and tracing out the currents. Remember that when a diode is conducting, it can (for all practical purposes) be considered a closed switch, and when not conducting it is an open switch. The problem is to find the voltage across the switch for a given polarity, taking into account all sources of voltage—including charged capacitors.

Mechanical stress

Transistors have acquired a reputation for being rugged, but there is a limit. The GE Transistor Manual informs us that a 4½ inch drop of a transistor onto a hardwood bench gives an acceleration of 500g; 30 inches onto concrete gives 7 to 20 thousand g; snapping the transistor onto a spring clip—600g. And

Table 1. Peak inverse voltage characteristics of popular rectifier circuits.			PIV Req'd with 71 V
Circuit	Description	PiV Across Each Diode	rms secondary
1 1000 pF 25V P	Half-wave, Capacitive load Half-wave, resistive load (not shown)	2.828 rms 1.414 rms	200 V 100 V
It 1000 pF	Full-wave, resistive or capacitive load	1.414 rms	100 Y
# \$500 pt	Full-wave bridge, resistive or capacitive load	1.414 rms	100 V
1 250, F 50V 1 250, F 50V	Tripler, quadrupler, etc.	2.828 rms	200 Y

even clipping the leads with side-cutters results in several thousand g. It seems to me that for practical purposes, the last-mentioned item is the most important, though you might take a little care the next time you 'throw' a transistor down onto the bench. If the transistor suffers too much vibration, the crystal will fracture, and that's it. I haven't had this happen yet, but now I snip the leads a bit more gingerly than before.

Thermal stress

There is a lot of argument on how much heat a transistor will comfortably take. Purists will have you hold the leads in heat sinks (e.g., surgical forceps, alligator clips). Others say to hold the lead with your fingers; if it gets too hot for you, it's too hot for the transistor, but this does seem drastic.

On one hand, it is obvious that the transistors will take quite a lot of thermal abuse, because they have to be soldered by dip processes into circuit boards, when leads are very short. And, I have unsoldered a number of transistors from circuit boards, and resoldered them into circuits without apparent harm—though for various reasons I do prefer transistor sockets. On the other hand, certain subtle forms of damage can be done to a transistor, germanium in particular, when heated only moderately.

It seems that when an alloy-diffused transistor, such as the 015 or 065 ($f_T = 70 \text{ MHz}$) types appearing on computer circuit boards (at ridiculous prices), is heated a bit too much, its dc current gain increases, and its high frequency amplification decreases. Amazing. This does not appear to occur with the lower frequency (6-12 MHz) alloy junction types (e.g., 033, 083). And from the experience of a friend, it appears that the response time characteristics of silicon transistors can also suffer when abused. This leads into the delicate matter I shall eventually discuss here.

In general, you need not worry much about overheating if leads are not too short, and if you apply heat quickly and decisively (with all surfaces tinned). But, if there is any question, and particularly if high-frequency response is important, it is a lot safer to use transistor sockets.

Power rating

If you are going to avoid heat abuse, you also have to avoid it after the transistor has

been soldered into the circuit. This is an enormous subject, and I can only touch it briefly here.

Remember that all transistor characteristics vary with temperature, usually for the worst. Leakage goes up alarmingly—particularly for germanium—and breakdown voltage goes down. But hrs (dc current gain) goes up sharply above 60°C, while hrs (ac current gain) goes up more slowly. For more details about this, as for much else, see the latest GE Transistor Manual, Chapter 6.

One of the most misunderstood ratings is that for power. One of the reasons why American ratings often appear to be so much higher than European ones, is that the former may be stated at 25°C case temperature, while the latter will be at some higher temperature. It is worth pondering over the various aspects of power ratings presented in the manuals and in the manufacturers' data sheets. The rating for power dissipation at 25°C (about 77°F) air temperature is a fairly practical one if a heat sink is not used, but requires that the air be allowed to circulate quite freely. For small transistors, the total device power dissipation given for 25°C air is about the same as for a 75°C case temperature, for silicon. If you want to dissipate more power, you have to use a heat sink, but in any event, it is important to keep the case temperature low enough. A rough rule of thumb is to apply power relatively gradually, until the transistor gets hot, but don't apply too much too fast! Germanium transistors should not get more than warm, nor silicon ones more than hot. How hot?

If you must obtain considerable power from a transistor, remember that the absolute maximum values are not necessarily design centers, but maxima. On the other hand, the power rating given depends on the case temperature, and the junction temperature can be higher for brief periods. How brief will depend on various things, and manufacturers' sheets should be consulted for high peak or pulsed operation. In any event, power can be dissipated as long as the average case temperature is reasonable. 75°C feels quite hot to the touch, while 100°C sizzles water or causes the experimenter to jerk his hand away so violently that the apparatus falls to the floor, thereby solving several problems simultaneously. Still higher temperatures will sizzle water more violently, and are to be avoided.

When a transistor is to be run hot, leakage considerations require that the baseemitter circuit resistance must be kept low, or very considerable base-bias stabilization be employed—for example, base bleed current equal to collector current if a germanium transistor, somewhat less for silicon.

Approximately two square inches of heat sink (i.e., one square inch on each side of a flat piece of metal) will dissipate one watt, while allowing the transistor (or diode) to reach 60°C above ambient. Since air temperature does not usually exceed 40°C (uncomfortable temperature for people), this seems like a good design value for silicon, though the prudent experimenter will increase the heat sink somewhat more, particularly if other warm things (including other transistors or diodes) are on or near the chassis. And, of course, the heat sink should be made of reasonably thick metal, preferably solid silver. Where this is impractical, copper or thick aluminum will have to suffice! The above considerations apply if heat contact of the semiconductor body with chassis is good. Use silicon grease and avoid mica if possible.

If you hope to get appreciable power out of high-power transistors at rf, remember that if the efficiency of a transistor decreases as frequency increases (e.g., above about $0.1~f_{\rm T}$) that represents increased loss, and that means that it will have to dissipate more heat for a given power output.

An embarrassing matter

I shall hide this point at the end of the article, in the hope that the casual reader will overlook it, while the dedicated will show understanding. The fact seems to be that it is indeed possible to overload a semiconductor partly, and thereby to degrade it without destroying it.

When they are abused, diodes or transistors do not *always* become totally "bad". This is because the semiconductor junction is metastable rather than directly unstable; it can be partly inactivated, or inadequately formed in manufacture. This has several interesting ramifications.

A damaged 600V diode may become a 100V or 50V—or even 30V—one. Therefore, always test "bad" diodes for PIV, unless the ohmmeter shows a low reverse resistance. Ohmmeter tests should be performed on the medium ohms range, because some very sen-

sitive ohmmeters can show a finite back resistance of diodes on the high-ohms scale, particularly for low voltage or germanium diodes. On the other hand, considerable care must be exercised when using the low-ohms range of an ohmmeter to test the forward characteristic of a low current diode (or small transistor) because some types of ohmmeters can pass several hundred milliamperes. This is particularly important if you plan to test transistors routinely with an ohmmeter; it should have a sensitivity at least 10k/V, and should not be used on the lowest ohms range.

Personally, I think that one should never use an ohmmeter for testing semiconductors; at best the reading can be misleading, and at worst you can ruin the thing you are testing. But some people swear by ohmmeters for this—it takes all sorts to make a world!

Now, I must emphasize that these instances of partly inactivated semiconductors only happen when conditions are marginal, e.g., when source current is limited to a value which will damage but not destroy the semiconductor on one cycle or the other. I guarantee that if you exceed the absolute maximum PIV rating of a diode in an ordinary rectifier circuit it will perish within one cycle. Thus the invalidity of "ICAS" is still maintained.

Sometimes the degradation may occur from overheating, and indeed this phenomenon can sometimes be turned to advantage. Some surplus silicon diodes have inadequately formed (?) junctions, and can be "cured" to increase their PIV. In practice, you apply reverse voltage as described above, through a large series resistance, and when you reach the turnover point (where the current starts to increase sharply with voltage), you leave it there. If the current through the diode goes down and/or the voltage across it goes up (whichever is easiest to measure), watch what happens. The PIV may increase to some high value and stay there, even when you come back to it later; in that instance the diode is "cured" and you have produced a higher useful PIV! Or the increase may not be permanent when you return later (after removing the power), in which case you must rate it at the lower PIV. Or the voltage across the diode may increase quite a lot, then suddenly fall to zero, permanently. Tough luck. In any event, it can be exciting if you are prepared to experiment a bit.

I have found that the curing process is

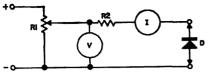


Fig. 3. A simple diode tester used by VK7RG for checking PIV.

accelerated, and made even more permanent, if the diode is heated. The heating can be either from external heat, or from the heat caused by forward current. Once, when I had to cure a whole batch of such beasts, I built a special power supply which applied suitable forward current on each half cycle, and the appropriate critical reverse voltage on the other. Does anyone know the reason for this strange curing phenomenon?

I ought to mention that when you are testing the reverse characteristic of a semiconductor, be sure that the current you are measuring is only that going through the semiconductor, i.e., not that going through semiconductor plus voltmeter. The currents involved are rather small, and the current required to drive even a VTVM can be large in comparison. In order to effect this testing more conveniently I have built a VTVM with a 250-meg input resistance; it is merely an ordinary push-pull type with meter between the cathodes, resistance of various amount (depending on sensitivity required) in parallel with the input grid, and 250 megs in series with input grid.

One fairly simple way to reduce measurement problems of this kind, is to measure the voltage on the power supply side of the limiting resistor (R₂ in Fig. 3), and calculate the diode voltage from Ohm's Law. In Fig. 3, for example, for a given I, the voltage E_d across the diode is

$$E_d = E_m - IR_2$$

where E_m is the voltage read from meter "V" (whilst ignoring the voltage drop of meter "I"), and I is the current through the diode. "I" may be a 50 μ A or 100 μ A meter and I

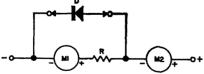


Fig. 4. Protecting a sensitive meter movement with a silicon diode. MI is the meter being protected, M2 is for temoprary measurements. The value of R is increased until meter MI reads about one-percent low as indicated by M2.

recommend that it be protected. The simplest protection is merely to shunt the meter with a silicon diode in the forward direction⁴. Still better protection can be effected by the temporary setup shown in Fig. 4. M₁ is the meter to be protected, and M₂ is a temporary current meter. D is any silicon diode. Just keep the current as read by M₂ at the full scale deflection (fsd) value of M₁, while increasing R. Increase R until M₁ reads about 1% low. Then replace R by the next *lower* standard value. This gives magnificent protection for M₁. Another diode in parallel with it, but in the opposite direction will protect for backward polarities, if relevant.

What do you do with a drunken junction?

Transistors can sometimes be degraded too, particularly if overheated. Their degradation may appear as lowered voltage rating. beta, frequency, or higher leakage. Therefore, a degraded transistor should be retested completely for all relevant characteristics including stability. If it shows certain characteristics on retesting, you can depend on those characteristics to remain stable (if it is not again overloaded), as though you had started with a poorer transistor-but on one notable occasion I found that certain transistors (diffused junction types 015 and 065 from computer circuit boards) which had been carefully overheated, increased their dc amplification factor at the expense of frequency rating. On the other hand, other transistors (alloy junction types 033, 083, ditto) didn't -so it is hard to predict behavior.

For my own purposes, I merely retest the abused transistor for voltage and gain, and dump it into the "general purpose" box, after writing the BV and beta directly on it. A friend goes even further, and won't have degraded transistors in his house. I have persuaded him to send them to me, and since his business results in a fair number of abused transistors, I have collected quite a nice pile of them. Since they were high performance Fairchilds to begin with, I have not been displeased with the resulting items with mere betas of 50-100, and such terrible frequency response as 100 MHz—heh!

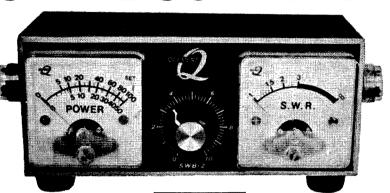
It should also be noted that even if one junction of a transistor is ruined completely, there is a distinct possibility that the other junction will still be servicable as a rectifier. This is particularly important for power transistors used as diodes, but can be useful for small ones too if you are short of junc-

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tion diodes. Indeed, under certain conditions where germanium junction diodes are required, these can be ideal: e.g., lower sensitivity to transients, lower forward voltage drop. But remember that a silicon transistor becomes a silicon diode, and is just as sensitive to PIV overload.

A fact often overlooked is that the reversebiased base-emitter junction of many silicon transistors makes an excellent zener diode in the 6-12V range, depending on the transistor⁵. Unfortunately, however, only good commercial transistors do well in this regard, and the dynamic resistance of surplus ones is often hopelessly high. Out of a dozen Fairchild SE1002 transistors I tested, all had base-emitter zener voltages of the order of 6.5-6.7V at 1 mA. From a comparison of the resulting dynamic resistance with that of regular 6V zener diodes, I calculate that these are equivalent to a 300 mW American power rating, or 150 mW European or Australian power rating.

Thus, even half-damaged transistors can be put to good use, if the other half works. Perhaps in this day of affluence and low semiconductor prices, this may appear to be in the string-saving category, but my attitude in matters of this kind is colored by years of supporting a potentially expensive electronics hobby on a student's salary, and partly by the fact that those 'inexpensive' semiconductors manage to become considerably dearer after Australian Customs and the local middlemen have had their bit. Even so, its great fun in VK7; why don't you come visit us sometime and see?

. . . VK7RG

References

- 1. For example, see 'Silicon Diodes and Common Sense," CQ, Sept. 1965 and "Silicon Replacement for Tube Rectifiers," QST, Jan. 1965; also "Zener Diodes", 73, October 1966.
- 2. This subject has been covered in some detail in a series of articles in *The Australian Equipment Exchange Bulletin* (P. O. Box 177, Sandy Bay, Tasmania, Australia) from July 1966 to July 1967.
- 3. See 73, November 1966.
- 4. "Protect Your VTVM", 73, August 1966, p. 82.
- 5. I strongly recommend the following articles to you: "Save That Transistor!", 73, July 1966.
 - "Zener Diodes", 73, October 1966.
- "Zeners as Hi-Cap Variable Capacitors", Radio-Electronics, September 1966.
- "Solid-State Tuning", Break-In, January 1966.
 "Varactors", Break-In, May 1966. ("B-I" is the ZL equivalent of QST, but much better because in part they show what more can be done with partial transistors, and because they continue this semiconductor discussion more fully on important and exciting properties.)

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DC VTVM

If you're in the need for a very sensitive, high-impedance VTVM, here is a design that is simple, stable and economical.

Can you build a better dc VTVM than you can buy? Well, I suppose that depends. But if you've never tried, why don't you at least breadboard this circuit? You may find that dc amplifiers and meter circuits are not so complicated after all, if you have some good ideas to work from. And here they are!

The finished instrument reflects my own experience in test and development work. The voltage ranges increase by factors of 2 or 2.5, from 1 volt full scale (through probe) to 500 volts full scale. Direct input sensitivity is 0.1 volts to 50 volts, and has proved very useful although you have to be careful with it. The bipolar scale eliminates switching, an annoyance around transistor circuits which often have some of each po-

larity; none too clearly marked. The test probe has three resistors totaling 18 megohms near its tip. This minimizes disturbance of circuits, even at rf. And an appropriate bypass capacitor eliminates noise transmission from the instrument back to the circuit under test.

Although the circuit will get by with almost any meter movement of a milliampere or less, long scales are rare. For instance, the nice Lafayette meters priced around \$4.95 have a 1-inch scale. But Selectronics is selling a meter with a 6-inch scale for \$4.50. That's large enough for hand manufacture of a new scale, and you have the option of making the job easier by going full-scale and adding a reversing switch.

Fig. 1. Front view of dc VTVM. It exhibits 18 megohms input impedance and has nine full scale voltage ranges from one to 500 volts dc.

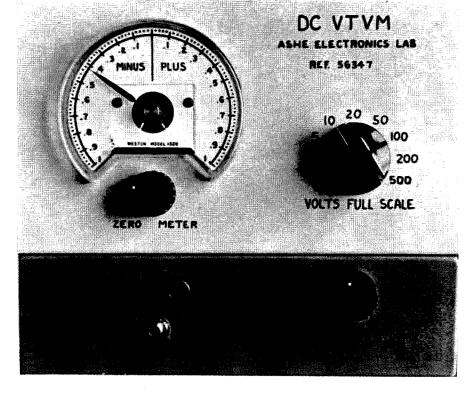




Fig. 2. Back view of dc VTVM. In this shot the OB2's were pulled out for a better view. The lip at top of the panel makes a convenient handle.

Circuit details

The instrument circuit breaks down naturally into four parts. They are the power supply, the input divider, the dc amplifier, and the meter driver. If you cannot exactly duplicate the circuit I have described, reread the description of the parts you're going to change, and then start breadboarding.

Because the two 0B2 VR tubes fix the critical voltages, there is no need to duplicate the supply section. Any transformer which will give you a filtered dc output of 250 to 350 volts at 20 mA or more and 6.3 volts ac at roughly 0.6 amps will be adequate. If you have any doubts about the transformer, make up a breadboard and load it to these specs for a few hours. It shouldn't get too hot to touch. When assembling the instrument, check the VR current for a minimum of 5 mA under operating conditions. I've added a neon lamp stabilized bias to the heater leads because this is said to improve tube life, and a small series resistor drops the heater voltage to within the manufacturer's specs. You have to watch that with "surplus" transformers! "6.3 volts" often turns out to be more like "big ballpark guess".

Instrument accuracy is established by the input voltage divider. But not all parts of the divider are equally critical! If the 18 megohms in the probe is in error, this constant inaccuracy can be corrected for all ranges by adjusting the calibration control. The nine resistors in the voltage divider string are the most critical, and it turns out

they are all values you can easily measure on an inexpensive impedance bridge. I bashfully admit I planned it that way. When building, proceed in this order. Find accurate resistors for the voltage divider. Then use three good resistors for the probe, 10% or 5% tolerance. Calibrate through the probe. Then choose a resistor for the direct input, near 180k ohms, which gives correct readings (at 10X sensitivity).

Your nine accurate resistors may be a problem. I selected ordinary half-watt composition resistors on my Heathkit impedance bridge, in some cases putting a small one in series with a large one, so as to hit all values accurately. I used heatsinks for soldering to avoid calibration changes. Perhaps the resistors will drift with time and need to be corrected later. You might prefer highly stable 1% resistors, choosing values close to those specified, and avoiding cumulative error, as you pass up the string, by selecting values on opposite sides of true figures.

A properly designed instrument will not introduce hum and noise into the circuit being studied. If the meter input line is acquiring some ac from a nearby power lead, this may be introduced into the probe and go on from there. But a large bypass capacitor keeps this line at signal ground, and it also slows meter needle response. My meter requires about 1 second to come to a reading.

Transistors are very nice for guaranteeing vacuum tube operating points. Not out of place at all, and since only dc conditions are important, an inexpensive transistor will do a fine job. If you've had experience with in-

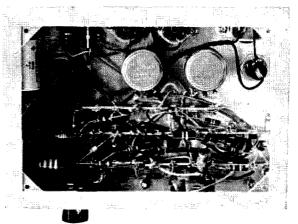


Fig.3. Bottom view of dc VTVM. Voltage doubler supply is in lower right hand corner on two lug strips on side of chassis. Circuit warmup time might be reduced by mounting the transistor on/top of the chassis.

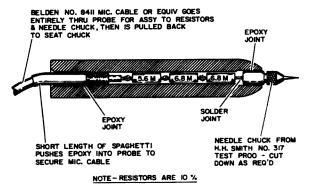


Fig. 4. Test prod construction. Simple design is permanently assembled with epoxy cement.

dustrial and computer circuits, you'll see why I call this arrangement "bobtail bias". The transistor fixes the current through its emitter resistor by guaranteeing the voltage across it, and this in turn determines the operating point of the 12AU7. The transistor base voltage is fixed by the divider across the zener diode. It turns out the zener is necessary for good stability, since the 0B2 regulated dc voltage is still pretty drifty. Choose the upper resistor (marked with an asterisk) for 3.4 volts across the 470 ohm emitter resistor. The tube cathode and anode voltages should come out right with no further effort.

The vacuum tube circuit is known as a "difference amplifier". It is used because of its relative stability: drift in one half is compensated by roughly equal drift in the other half. The circuit seems to compare voltages applied to the grids, amplifying the difference. For instance, if both grids go one volt positive, the cathode does too. Tube current remains constant, and there is no output. But if one grid goes positive and the other does not, the tube currents are unbalanced and there is a net output. This is why you cannot eliminate the apparently superfluous resistor and capacitor to ground from pin 7. There is some grid current and

noise pickup, which only balances out if both grids see the same view to ground.

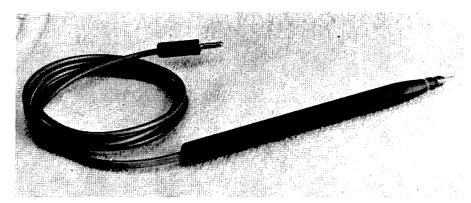
You may find some advantage in selecting the amplifier tube for stability and minimum grid current. The coarse zero control is large enough to compensate for more than the usual variations in tube properties, but some new 12AU7A's show better stability than others. Grid current in my meter produces about a 2% zero drift in going to the lowest range, which is not inconvenient, but a selected tube could probably improve on this. Don't try to use a surplus or computer variety tube for this application, because they were not as carefully controlled in manufacture as the ones you get in your nearby service shop. The state of the art has changed!

Since there is no negative supply voltage and a pot in the cathode circuit would spoil the nice properties of the difference amplifier, the meter Zero control is a variable resistance in one anode circuit. If the anode voltage is too high, we just put in a little more resistance to bring it down. Works fine. I've found the 12AU7A's are quite variable in the amount of correction required, so one large resistor is placed in the chassis, and a small one in the panel for vernier corrections.

The Selectronics meter has about a 1000-ohm coil, and requires 500 microamps for full scale deflection. This is a heavy load for a small, low-current vacuum tube. So I've added a cathode follower to drive the meter. This enables the difference amplifier to operate at full gain of about 10. Because the cathode follower is heavily loaded, overall voltage gain is about 3.

The electrical connections to the meter are in the insulated wire extending from the back, and the two studs also extending from the back. If you wire the circuit as I've shown in the schematic, the lead goes to the calibration pot and to pin 3; the studs

Fig. 5. The finished test prod. Make the cable a little long and shorten it if necessary.



to pin 8 of the 12AU7A cathode follower. This gives upscale deflection for positive voltages. The wire lead is the meter's positive terminal.

A small precaution is required to eliminate a front panel shock hazard. Cut or break off the two-fingered zeroing extension from the meter face into the movement. It's nickle-plated, soft brass. You find this inside the cover, not the movement. Careful, the zeroing screw is mounted in thin plastic! This connection should be broken because the meter movement operates at 12AU7A anode voltage.

If you want to use a single-ended scale, put the scale reversing switch in the difference amplifier grid circuit. For positive voltages, one grid to ground and other for signal; for negative voltages reverse grid connections only. You will probably find that you do not need to switch in a new calibration control for the reversed ranges. By swapping grid connections, the tube sees nearly the same operating conditions with

opposite polarity signal input, so calibration should not be disturbed.

A lower-range meter may be used simply by changing the value of the calibration pot. A larger resistance reduces the current that flows through the meter for a given input voltage. A 50-microamp Lafayette meter (\$4.95) worked well in a breadboard test.

Construction

The VTVM is assembled on a 5 x 7 x 2 aluminum chassis, with a 4 x 7 inch panel tilted back % inches at the top. A lip 1½ inches wide takes a 1 inch wide vertical brace at each side for reinforcement. The lip is folded down a quarter inch at the back for reinforcement, also giving a convenient handle effect for picking up the instrument. The four little diagonal pieces visible in Fig. 3 are braces omitted from many chassis but used in Premier products. They do much to strengthen the chassis.

Parts positioning is not critical, but the signal input leads should be kept well clear

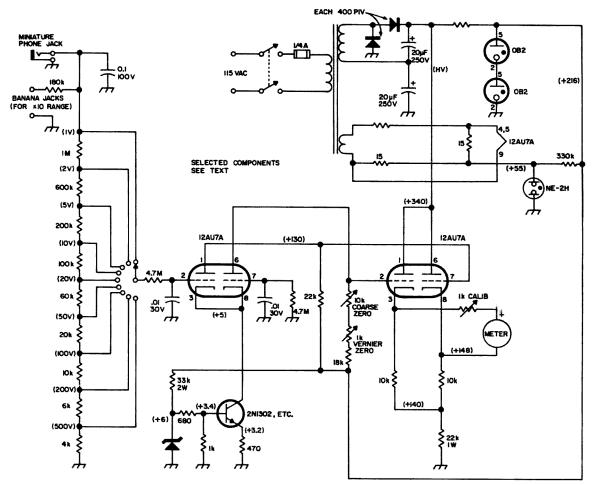


Fig. 6. Schematic of the dc VTVM. Note voltage readings. Arrows beside pots indicate direction of clockwise rotation as seen from the front.

of the heater and 115-volt input wiring. The ac won't affect the instrument but you don't want it going back into the circuit you're observing. The voltage divider uses two 1pole, 11-position wafers, the front one serving only for tie points. They are mounted on the appropriate manufacturer's shaft assembly, which may be supplied separately.

I mounted the transistor socket by its leads on two solder lugs. The wiring follows no special layout but parts close together on the schematic appear near each other in the chassis. The statistics on the five large solder lug strips are 28 insulated lugs and five grounded lugs used. B negative and signal ground go to the metal chassis. The TV cheater cord power input is very convenient

and only costs a few cents.

Since the Selectronics meter comes with no mounting brackets, the simplest way to install it is to glue it in. An Adel nibbler cuts a nice square hole, slightly oversize, and you might clean it up with a file. After painting, scrape off a couple of patches under the meter, roughen the plastic that goes over them, spread a thin layer of good epoxy glue, and slip the meter case in place. Leave the cover off. Let the panel rest overnight

face up to complete the job.

I made the probe from a handy piece of phenolic plastic, a half inch diameter by 6inches long. Details in Fig. 4 and 5. The rings around the lower end serve to indicate where the end is without looking at the probe. It's all held together with epoxy resin. Each half-watt resistor is rated at 300 volts so it's quite safe for poking around in circuits within the normal range of the instrument. The needle chuck is cut down to reduce probe capacitance. I have a strong preference for the phono needle tips, since they can be wedged into something while making a measurement and do not slip off when you look up at the meter.

An alternate probe construction would resemble that shown, but you could use an H. H. Smith type 317 test prod as a start.

Meter calibration

The meter scale is large enough to draw by hand in real size. Instead of going into terrific detail, I'll pass on some suggestions. You can browse around in a couple of drafting books for the necessary background. You will need a basic set of drafting instruments, which are usually available somewhere. Try a nearby school. If you're not a student, you

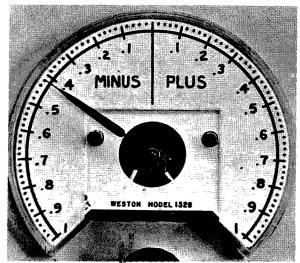


Fig. 7. Closeup of new meter scale, cover removed. Needle is at resting position with power off. may be a taxpayer helping to support the school.

Fig. 7 shows a scale done with a Leroy penholder using a #0 tip. A soft drafting pencil, properly used, will do a very acceptable job. You may feel more comfortable working in pencil if you lack previous drafting experience. Work on a piece of ordinary white filing-card stock. When the scale is prepared, spread epoxy cement thinly over the entire back, place the new scale over the old one and let the epoxy harden. If you don't like the end result, acetone attacks the epoxy. You can clean up and start over.

Begin by copying Fig. 8 onto the white stock. Ink or heavy in the scale arc, the center zero line (if used) and perhaps part of the lettering. Cut out careful, straight lines with straightedge and razor blade, the outside curve with scissors. Save the waste. You can fit it back into the scale to find the cen-

ter for finishing up.

Masking tape will hold the scale in place well enough for calibration. Tiny pencil marks will indicate the new scale location over the original scale, since you must remove it for completion after calibration. Locate the endpoints by applying full-scale voltage in opposite directions. Find the nine intermediate points by draftsman's construction, or preferably using a Voltage Calibrator, because the meter movement isn't perfectly linear. See 73, January 1967, page 70. Set the VTVM to 10 volts full scale and make a tiny pencil mark at each volt deflection. Return the scale to the drawing board for finishing, and then install it permanently.

The meter as received has its zero at the

conventional left-hand end of the scale. I rezeroed it up-scale by turning the hairspring attachments in the appropriate direction. About 90 degrees was the maximum available correction, the same change being made in front and back hairsprings. This brings the needle to the position shown in Fig. 7, and the zeroing to the new scale is completed electrically. This gives a possibly unnecessary option for future adjustments in either direction.

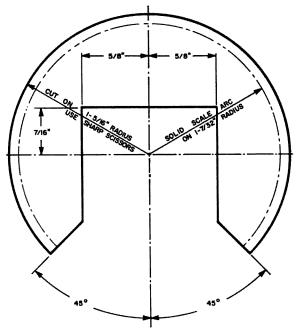


Fig. 8. Drawing for getting started on a new meter scale. Paper stock will not change calibration with humidity if properly glued to metal backing.

Finishing up

All amplifiers show slow drifts which are lost in the capacitive interstage couplings of the familiar audio and rf amplifiers. But dc amplifiers see the drift as signal. This drift problem is usually dealt with by using very stable supply voltages and incorporating additional elements whose drift is about equal and opposite to that anticipated in the signal part of the circuit.

If your meter shows erratic zero behavior five minutes after a cold start, or annoying drift later than 20-30 minutes, look for a faulty circuit or component. The best way to find the trouble is to choose one small region or candidate at a time, and invent a way to test it without disturbing everything else.

A surplus zeroing pot may have aged more than anticipated since last used, and be making poor contact. Let it hang by its leads so the shock is not transmitted to the chassis, and give it a rap with a small screwdriver handle. If the meter needle jumps, the pot at least needs some contact cleaner. Check other pots the same way, and poking at joints with an insulated rod will uncover poor solder work.

Having eliminated all possibilities in the chassis, rap the tube. As the tube warms up, mechanical stresses develop inside. One or two raps will relieve these. If the meter needle starts jumping one way and another on successive raps, you want a different tube.

Use a *Variac* to adjust the line voltage in little jumps. If the meter needle follows these jumps quickly, check the 0A2's, the zener diode, and the bias transistor in that order. Slow drifts are acceptable.

Your finished meter should be well-behaved and long-lived. I don't think the circuit can hurt the meter movement, but then I haven't really tried. I hope you won't either. Perhaps a pair of germanium diodes in series each way across the meter coil would be good insurance.

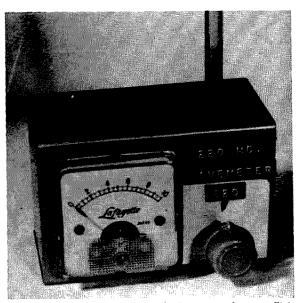
The direct input times 10 ranges turned out to have an immediate use I could have anticipated but somehow didn't. They're great for checking and neutralizing tiny VHF amplifiers. I'm working up an rf probe now, and if it doesn't appear in this issue of 73, look for it soon!

... W2DXH

National Bureau of Standards

The new 1967 edition of NBS Standard Frequency and Time Services, has just been released by the U.S. Government Prinitng Office in Washington, D. C. Known as Miscellaneous Publication 236, this eleven page pamphlet describes in detail the many services provided by the National Bureau of Standards' four stations, WWV, WWVH, WWVB, and WWVL. All but WWVH, which is on the island of Maui, Hawaii, are located about six miles north of Fort Collins. Colorado. NBS Frequency and Time Services may be ordered for 15 cents a copy from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; the Clearing House for Federal Scientific and Technical Information, Springfield, Virginia 22151; or from local U. S. Department of Commerce Field Offices, and at the NBS Boulder Laboratories.

A Wavemeter for 220



The 220 MHz wavemeter built from a Lafayette TM-14 Radio Field Indicator.

I have frequently noted the old Lafayette model TM-14 Radio Field Indicator among the archives in many hamshacks. I had one collecting dust and decided to see what would evolve with a little experimentation. Result—a wavemeter for 220.

First, remove all the "innards" except the meter on the front and the antenna receptacle on the top. This includes the phone jack on the rear and the magnet attached to the back cover with two screws (unless you enjoy having the wavemeter dangle precariously from some nook or cranny). Slightly enlarge the rear phone jack hole, insert a nibbling tool and cut out the back. Take a piece of fairly stiff plastic, slightly larger than the hole you just cut out and glue it on the inside. Put the cover aside and let it dry. You can still get readings on the wavemeter without this plastic window in the rear, but only a small fraction of the meter swing with it installed.

In my model a small Mylar .01 µF capaci-

60

tor was connected across the meter terminals.

In the vacant "pot" hole in the front panel, install a small 15 pF variable capacitor. Next, install the diode. I used a General Instruments DR303, but I am sure the more popular 1N34 or other VHF diodes will do as good a job. Coils LI and L2 were made of very small plastic covered hookup wire (about #24). LI is 1 turn, ½" in diameter; L2 is 1½ turns, ¼" in diameter.

My unit covers from about 185 MHz to well above 260 MHz. It should be stated here that some experimentation may be necessary with coils LI and L2 depending upon what diode and/or capacitor is used. Use a grid dip meter for calibration. This unit has been tested with several different grid dip meters and the results are the same on each, so it works out well and will give you a "working piece" of equipment rather cheaply if you are interested in the 220 band. It can be seen that with some experimentation this unit can be adapted to other bands of your choice.

Finally, with the weak signal emanating from a grid dip meter, I had very little success in picking up a reading using the reinstalled antenna, but received excellent readings by placing the plastic rear opening as close as possible to my source of signal. With a stronger signal the antenna can be used successfully to obtain readings without getting close to sources of rf. . . . WA2TOV

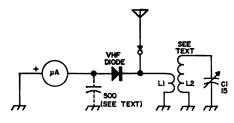


Fig. 1. Schematic diagram of the 220 MHz wavemeter. The coils are described in the text.



Second Ham Tour Of Europe

The ham tour this coming spring will be a happening that you will remember all your life. If you can possibly get away you should join our happy group traveling through Europe.

We have picked three weeks in spring as the best time of the year to visit Europe. Not only is the weather usually at its best at this time of the year, but we will be getting there a little before the big crush of tourists and won't find things all jammed up. A little later on everything fills up, it rains, and prices skyrocket.

prices skyrocket.

We'll leave Boston on May 11th (Saturday) and fly first to Paris, where we will be met by a delightful group of French amateurs who will help us to see their fabulous city and perhaps entertain us a bit in their homes. We'll suggest things to see and tell you how to get around in Paris, but there'll be none of this guided tour baloney. You see what you want to see, not what we decide you should see, Louvre? Fine, you'll find a goodly group going there. The fleshpots? Heh, heh! The famous Flea Market? I'll bet a lot of us will be going out there Sunday morning to pick up some bargains.

Next stop is Vienna, home of the most

Next stop is Vienna, home of the most wonderful pastries in the world. We'll try to have some tickets for the Spanish Riding School for those of you interested in this historical show. We're planning a get together with the Viennese hams at a hourigan where we all sit around and drink fresh wine, a Viennese specialty.

Viennese specialty.

In Berlin we will have two guided tours, one of the western sector and one into the Communist Eastern Zone, through Checkpoint Charlie. You can bring your cameras and take pictures of the stark differences between the two worlds . . the Wall . . . and incredible Berlin itself. The hams there are expecting us and we may have another great party together with them as we did on our first Tour.

The final city on our greated tour will be

The final city on our second tour will be Frankfort, where the local amateurs are eagerly looking forward to our visit so they can show us this historical area. Castle lovers can sate themselves. Car lovers will find Stuttgart just down the autobahn where he can visit the Porsche or Mercedes factories. Food lovers will go right out of their minds here. here.

In all we will be visiting four cities, staying about five days in each, which will give us a chance to see enough to want to come back for more and meet a number of the interesting amateurs who live locally. We will be staying at good hotels, but not at the very high priced international type hotels which are just about the same as staying in the U.S. By visiting the local hotels we get to live in the European manner and get a lot more out of our trip. It is the difference that make a tour enjoyable, not this business of never leaving home.

What Will The Tour Include?

There are considerable economies to traveling in a group. We will save enough just on our air fare to cover the bulk of the expenses of this trip. The trip fee will include jet air transportation for the entire trip, buses to and from the airports to the hotels, your hotel room, including breakfast, airport charges and taxes, sightseeing in eastern and western Berlin, and entertainments with local amateurs in all cities. You'll have to bring along enough money for your lunches and dinners. These are not included because we figured you'd like to make your own plans most of the time. Just about everything else will be paid for. There are considerable economies to travel-

OK, How Much?

The regular Economy fare to Vienna is \$602. This is the lowest fare that you can get to fly this far. Most tours like this are run for a profit and you would have to pay about \$1000 per person. Our interest is international ham friendship and our fare is \$990. But that is for **two** people, not one. That's right, just about half the regular cost of a tour like this. Singles will be \$520 each.

We must know soon if you and your wife are going on this trip so please send \$100 deposit quickly so we can make the reservations for the air seats and hotel rooms. We will probably have lots of room if you have a friend and his wife who want to come along

a friend and his wife who want to come along too, ham or no.

We are planning on leaving Boston on the evening of May 11th and returning 21 days later on Saturday June first, arriving in the evening. We will be in Paris on May 12-16, in Vienna on May 17-21, in Berlin on May 22-26, and in Frankfort on May 27-31.

Europe will be in the full bloom of spring during May. It will be moderate in temperature, requiring a light coat in the evening. The daytime temperatures will probably run about 65-75°.

about 65-75°

Cancellation

Your deposit will be returned if you cancel out up to 60 days before the tour. At that time we have to bind the airline seats and we lose the money if you change your mind. My wife and I will be guiding the tour and we are looking forward to having a lot of long ham talks with you. Well, I am; my wife will have lot of things to talk with your wives about other than ham radio.

Please let me hear from you soon . . . and don't forget that \$100 deposit made out to 73 Magazine, Peterborough, New Hampshire 03458.



Lufthansa

Howard Pyle W7OE 3434 74th Avenue, S.E. Mercer Island, Washington 98040

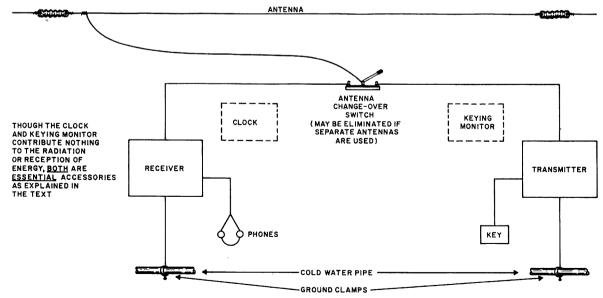
Choosing Accessories for the Novice Ham Shack

As a youngster you became the proud possessor of your first bicycle. Basically, this was nothing more than a pair of rubber tired wheels mounted in a metal frame equipped with a steering device, a seat for the rider, a braking device of some sort and a manual propelling mechanism. As your riding ability improved, you no doubt added numerous gadgets from time to time, generally for two reasons. First, and at your tender age probably of most importance, was the fact that other kids had them . . why not you? Next in line came increased comfort, pleasure and safety in your cycling. A horn, bell or siren, a hickey which when rubbed by your spokes in motion produced a somewhat doubtful facsimile of a high powered motor, lights of various types, reflector buttons, a carry-all basket . . . maybe even a multiple gear assembly. You probably wound up pedalling the equivalent of your own weight in accessory equipment!

When you entered the teen-age driving group, no doubt you acquired a car of sorts, probably of rather questionable vintage. Enough of the little boy acquisitive instinct remained so that it wasn't long before a

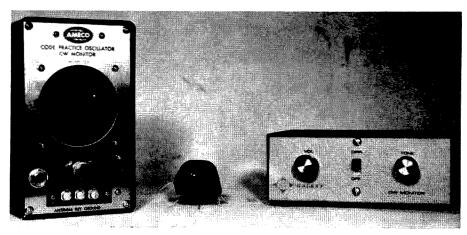
myriad of decorative (?) if not always useful gadgets, began to adorn your chariot. A radio antenna (although probably no radio!) served as an admirable support from which to display a furry fox-tail. Permanent removal of the hood provided an imposing view of chrome plated twin carburetors, distributors and like contrivances which took more time than your homework to keep in a highly polished state. Various mottled paint jobs in weird designs and often including infantile slogans and wise cracks, made for a 'posh' appearing vehicle and among the coke and hamburger crowd, you were 'in'.

Somewhere along the line you picked up an urge to become a radio ham. So, you went through all the 'chairs', resignedly learned the code, more or less studiously absorbed some of the elementary principles of radio communication and the pertinent laws and regulations. Eventually you procured your novice license, scraped the bottom of the barrel in your modest little savings account and acquired the basic station equipment with which to get on the air. This is where our story begins.



Basic equipment for the novice station. While the clock and keying monitor contribute nothing to the radiation or reception of energy, both are essential accessories as explained in the text.

Complete pre-wired combination rf monitors and code-practice oscillators are shown at the left and right. The dome-shaped module in the center contains the basic components from which the home builder can construct his monitor oscillator.

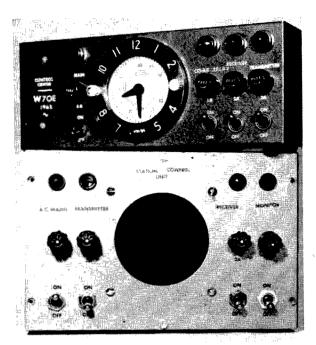


Just what is 'basic station equipment'? Pick up any ham magazine or handbook and you'll find dozens of illustrated descriptions of antenna tuners, SWR meters, coaxial relays, converters from this to that, and scores of similar items so 'essential' to ham radio operation or so the printed word suggests. For all the world just like you found in earlier days in the handsomely lithographed bicycle and auto accessory catalogs and literature! Your basic bicycle or tin Lizzie if they would run at all, would get you there without being equipped with all the fancy doo-dads and superfluous junk that was displayed on colored pages to tempt you! So it is with ham radio; your initial essential equipment with which to establish two-way ham radio communication over hundreds, yes thousands, of miles is no different than your earlier 'barefoot' bicycle or stripped down jalopy! A small radio transmitter (remember, 75 watts is the maximum legal power limit for novices), a hand telegraph key, a receiver and an antenna comprises the basic novice amateur station; that is all you need to put an effective amateur radio station on the air!

"But" you ask, "what about all this other stuff that is always being pushed at us in magazines and handbooks and in their advertising pages?". Simply 'forget' all that guff in your initial indoctrination period in ham radio; before you become steeped-in and utterly confused by what are to you many meaningless terms, get the hang of being a ham by doing things the simple way at first. There is plenty of time ahead to acquire and learn to use the more intricate gadgets as you progress up the amateur radio ladder. And now, against the time when such gear begins to really have meaning for you, suppose we give you a few tips in beginning the expansion of

your station equipment.

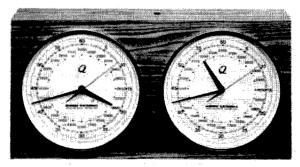
Let's first spend a few minutes on the subject of antennas. If you've been smart you've started your on-the-air activity with a single strand of ordinary antenna wire, 50 to 75 feet long, suspended between your chimney and a convenient tree maybe, or some other means of support at each end. A single piece of antenna wire brought down from the horizontal span from either end or even from the middle or other convenient spot, will run directly to the blade of a simple, single pole, double throw knife switch to switch your antenna between the transmitter and receiver. One jaw of the ects to the antenna terminal on switch conyour receiver, the other to the antenna connector on your transmitter. A single piece of wire, bare or insulated, connects to the ground terminals on both the transmitter and receiver and continues to the nearest cold water pipe; this completes your antenna system. Note that we skip any such trick devices as antenna tuners or matching units, SWR indicators, band-pass filters and the like. In this early stage of your ham endeavors you just don't need them, and ten to one, they'd only confuse you and you'd adjust them wrong anyway, resulting very probably in some disappointing contacts, if you make any at all. So much for your antenna then, but let's make one more point before we proceed to the next subject. We are assuming, in ignoring any attempt to include an antenna tuner or matching device as a separate item, that your transmitter is equipped with the conventional pi-network output circuit which 99% have. Such will handle your loading and matching adjustments very nicely without any extraneous equipment. If however, you have some 'off-breed' output circuit in your transmitter, you may need some ex-



Simple control centers for the novice station: the upper unit includes the station clock; a loud speaker may be substituted as shown in the lower unit.

ternal matching device to permit proper adjustments; better to choose a transmitter which incorporates a pi-output network. We don't in the least mean to disparage the *eventual* use of various tuning devices, filters etc., in connection with an antenna system; what we do want to emphasize is that until you have progressed to the point where much of the literature which covers more elaborate antenna systems begins to make sense to you, you'll have mighty good luck and make many contacts with other hams both local and distant, if you let *simplicity* rule your initial efforts.

Now that we've settled the antenna question, let's go inside and have a look at the shack set-up itself. Remember, we have one object in mind . . . elimination of any non-



Photograph courtesy Quement Electronics
This double-faced clock is particularly useful because
one can be set on local time, the other on GMT.
\$24.95 from Quement Electronics, 1000 South Bascom
Avenue, San Jose, California.

essential accessory items but without sacrificing the few which will contribute to more comfortable and convenient operation. You have a satisfactory transmitter, receiver, hand-key and antenna changeover switch. This is your basic communication equipment which makes two-way contact with other amateurs possible. You can however, add a few items which will provide for more operating convenience, although they will contribute not one iota to increasing the transmitting or receiving range of your station; let's see what they are.

First, let's pick one, which in addition to adding to your operating convenience, also happens to be a legal requirement for all classes of radio stations . . . an accurate time piece. This obligation is legally fulfilled through the simple expediency of a wrist watch worn by the operator or a somewhat passe pocket watch. Neither however, always represent a 'convenient' means for timing your log entries and your tenminute station identification breaks. A reasonably accurate conventional alarm clock perched atop your transmitter or receiver will of course, fill the bill and provide comfortable visibility. However, inasmuch as considerable amateur operation is based on using Greenwich Mean Time (GMT), a so-called "24-hour clock" is most convenient. These are available in either the familiar circular style or the horizontal read-out, often called a 'jump clock'. One manufacturer even offers one of the latter type with a built-in ten-minute alarm buzzer (can be switched on or off) to remind you to identify your station each ten minutes as required by FCC regulations. And, while we are on the subject of clocks, a most novel offering is available in a 24-hour international time indicator which tells you at a glance, not only your own local time, but that in any part of the world! So, providing yourself with the best clock your piggy-bank can handle is not only legal compliance. but an investment which will serve you throughout your entire ham career.

Next in order of importance in station accessory equipment, is a CW keying monitor. While not legally required, it should be considered one of the most desirable accessories in *any* ham station; this is particularly true for the novice class. The novice understandably approaches his telegraph key initially with some timidity. He is about to put a radio telegraph signal

on the air which will be heard by countless hundreds of other stations! His previous operating experience has been limited to practice work with a local oscillator which was also used for his formal code examination. His 'fist' or formation of code characters will be shaky at best. Without some method of 'monitoring' his own sending, he cannot evaluate his spacing or the proper formation of his dots and dashes. The result is often a barely understandable transmission which frequently penalizes him by a frustrating lack of contacts with other stations. Some hams resort to listening to their transmissions by using their own receiver as a monitor. This is an unsatisfactory and make-shift method, particularly for the novice who seldom works with other stations having identical crystal frequencies. This means retuning the receiver for each transmission and reception, an awkward procedure at best.

Fortunately, a number of manufacturers offer CW keying monitors of various types and over a rather wide, though nominal price range. Basically the majority provide an audio tone of a pleasing pitch, fixed in some but variable in others. The volume of the monitor signal produced is also fixed in the simpler types but may be varied in those of more elaborate design. Practically all of them have the desirable feature of serving as code practice oscillators as well, and when so used, neither the transmitter nor receiver need be turned on.

Many such monitors require *no* connection to either the transmitter or receiver; they operate as an entirely independent unit. Such are activated by the stray rf currents present in the vicinity of a transmitter or feed line. It should be remembered though that the tone produced by the monitor is *not* that of the actual rf signal being radiated; this can only be checked by listening on a conventional oscillating receiver. The monitor tone is that generated by it's own integral oscillator.

As we mentioned previously, such monitor devices are available in a number of types; they can also be purchased in either



Photograph courtesy Pennwood Numechron Company.

A 24-hour digital clock with horizontal readout and ten-minute identification reminder alarm.

kit form or completely factory-wired. While all are nominally priced, at even less cost a ham can easily make such a simple device himself. Handbooks and frequent magazine articles offer construction details covering those of the 'home-brewed' variety. Recently one manufacturer has simplified such monitor construction by making available a rock-hard plastic module in which the transistors, resistors and capacitors forming the heart of the monitor circuits are imbedded. Five protruding wires permit ready connection to a flashlight battery, loud speaker and a short piece of wire for an rf pickup antenna; that's all there is to it!

Whatever you choose in the way of a monitor, you'll find that such a device will result in helping you to rapidly improve your character formation, which, in turn, will gain you a gratifying increase in the number of contacts you make. While we're on the subject of 'keying', it is probably a good time to inject a note of warning; to emphasize one accessory item that should never be included in the novice station equipment until he has become thoroughly proficient in transmitting with a conventional hand telegraph key. We refer of course to the 'semi-automatic' type of keyer, more often referred to as a 'bug'. In the same category is the so-called 'fully automatic' electronic keyer, a more recent development. Either of these devices in the hands of an inexperienced operator positively



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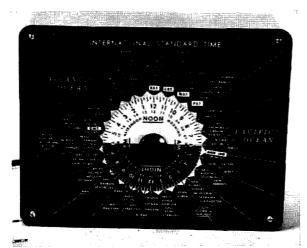
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Photograph courtesy International Time Recorder Company.

This novel world time device makes a valuable addition to any ham shack. Available from International Time Recorder Company, Post Office Box 165, Albany, New York for \$12.50.

murders the telegraph code! Making as they do, a string of dots or both dots and dashes by pressing the actuating lever, they will run wild until the operator through constant 'off-the air' practice, has mastered the fingering technique essential to forming readable characters! Buy one if you must, but before ever making a single dot on the air, spend a good many hours using it with a code practice oscillator. To put it on the air without proper finesse will earn you only the wrath of your fellow hams; many of them will avoid answering your calls entirely!

Not so important an accessory to station operation, but adding greatly to operating convenience, is a 'station control center'. Such is not available as a commercial product probably due to the great diversity in operating requirements. It is strictly a home-brew project and can be made as simple or as elaborate as the builder feels warranted, over a wide latitude. A control center is just what it's name implies; a point from which control of all of the equipment in the shack is centalized. Each item of equipment can be individually switched on or off at will at the control center and by appropriate panel indicating lights, the equipment in service can be immediately determined at a glance. Individual, independent fusing for each item of equipment should be provided for in the central unit as well. Remember though, to either jumper out the fuse in the equipment cabinet itself or replace with one of substantially higher current rating so that in the event of fuse failure, it will be in the control center itself. This will save you many minutes in hunting out the faulty fuse and this can often be real time-consuming, particularly in equipment where the manufacturer has seen fit to bury the fuse well within the confines of the chassis, requiring removal of a generous handful of screws to gain access!

Work out your own design for a control center, build it well and provide sufficient switches, fuses and indicator lights to permit adding control of additional equipment as you acquire it. By all means, provide a 'main switch', fuse and panel light, wiring it so that by simply throwing the main switch to 'off', all power is removed from the control center and thus from all equipment. At the end of an operating session then, you need only throw the main switch and hit the hay, confident that you haven't inadvertently left one piece of gear 'on'. Control centers can of course, be expanded to house many other equipment components than merely switches, lights and fuses. Some hams choose to mount their station clocks therein; others prefer to house a speaker in the cabinet. CW code monitor components can be incorporated . . . noise limiters, audio filters . . you name it. The control center is one piece of gear where you can let your design ingenuity have full play!

The foregoing paragraphs pretty well cover the accessory equipment which will bring the novice station into an effective and convenient modern amateur radio station which will readily lend itself to future expansion as the owners' experience increases and his license grade advances. Then, and not until then, should be begin to evaluate his antenna system and his over-all equipment installation with increasing efficiency in mind. He is ready then to think in terms of antenna tuners, folded dipoles, beams, a VFO, perhaps a linear amplifier. As the pages of handbooks and magazines obviously indicate, the realm of amateur radio has no bounds . . . it is one of the very few hobbies which never stands still; how far you pursue it is strictly up to you. Be methodical though in your approach; keep it simple at the outset, add equipment as you 'grow up' in ham radio and enjoy this most fascinating of all hobbies to its' fullest measure.

. . . W70E

Trim for Ten

The design of a pi-network that will tune 80 thru 10, can become quite a problem. To retain a high "Q" on all bands requires a large tuning capacitor for 80, and a small capacitor for the 10 meter band. The basic, or full open capacity of a large plate tuned capacitor is at times almost too much for ten meters, and the tuning is very sharp and critical since all of the rotor plates come into mesh at the same time.

There are several ways to solve this problem. One way is to use two capacitors ganged together with a switch to select the large or small. Another way is to use fixed capacitors with a rotary switch to select the size that is needed. This switching system is at times very difficult to design and keep working for the average home builder without machine tools, etc. The easiest way to have a smooth, one knob, switchless tuner is to modify a stock capacitor to alter the basic capacitance and the linearity of the capacitance turn rate ratio.

This modification will spread the tuning of ten and fifteen meters to about twice the range obtainable with the stock capacitor. The basic capacity is slightly lower and the linearity curve has a swoop rather than a straight line. The total, full mesh, capacity is lower, but that can be overcome by starting with a larger capacitor. What is gained is that the capacitor is turned through almost twice the range from basic capacity to 100 pF, spreading out this area of tuning; very similar to the bandspread on a receiver.

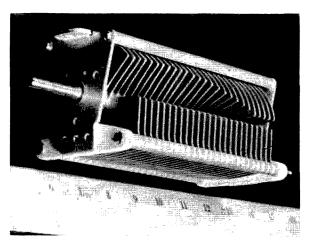
The modification starts with a stock capacitor and a few hand tools. Remove the rotor from the capacitor and trim some of the rotor plates so that they are smaller than the original half circle shape. Instead of the 180° shape, trim them to 120° for about half of the length of the rotor. About half way down the rotor, start leaving about 5° more on each plate as you work your way along. Leave the last few plates as they were originally. This will give a taper to the trim as can be seen in the photograph. The trimming must be done with care so as not to bend or distort the plates, or loosen them from the shaft. The cut edge

can be smoothed with a fine file and finished with fine emery paper. All exposed plate edges must be free from nicks or sharp points, as arcs will jump from any point much more easily than from a smooth edge or surface. Rough alignment can be made, and the capacitor reassembled. Final alignment of the capacitor plates can best be done with a pair of long flat-nosed pliers, or duck bills. A layer of plastic tape on the jaws will avoid nicks and scratches during this process.

The point to remember before starting this is to trim the plates on the approach side of the rotor as the tuning is done. Hold the capacitor in your hand and look at it as if you had it in the rig. Tune the capacitor and, with a crayon, mark the rotor plate end that starts into the stator. If you trim the wrong side of the rotor plates, you will have to tune counter-clockwise, or turn the capacitor end for end in the rig and put an extension on the short rear shaft.

The picture shows the overall look to the finished capacitor. The taper or stagger trim starts halfway back on the rotor. The rearmost plates are the original shape and the front plates are trimmed. Good luck with this simple modification and enjoy easier tuning on ten and fifteen.

. . . DL5AF



The trimmed variable capacitor which provides easier transmitter tuning on 10 and 15. About 60° is trimmed off half of the plates; a slight taper brings them back to the original size toward the rear of the capacitor.

The Longest QSO

How to yak and love itl

I am sure that there are many people who will scoff at this account, think that we are nuts or something, but here it is all the same, the account of the longest unofficial two-way QSO on Amateur radio.

After the moving van had left our new QTH, and the boxes were unpacked, I proceeded to temporarily set up my 6-meter beam in the good old Pennsylvania clay, unpack my HE-45A, and get used to the new location. After about a week of operating, I called a teenager about my age whose name was George and who lived

Movi ng

... I proceeded to temporarily set up my 6-meter beam.

about 10 miles away. I discovered George was the off-beat type with a big mouth, and since I was about the same, we had some long, drawn-out OSO's.

One day in July my copy of 73 arrived, and when I read about their RRC° award (the one you get for yakking for 6 hours), I gave George a shout, and he jokingly replied, "while you're at it, why not try to talk for longer and break the world record of 85 hours?" Completely serious, I replied, "That would be fun. But lets try for about 100 hours to be on the safe side." The reply I got was extremely watered down, as there are FCC monitors around. However, George finally agreed, and preparations were started for the longest QSO in history.

A system was worked out, and is as follows: the two of us would be at one QTH, and two friends would operate at another. Rigs were checked out, new tubes put in, parts replaced, as this would be the all important link. Tents were set up at both QTH's because it was necessary to become self-sufficient (as the parents would not have appreciated an extra person hanging around for 5 days). Sleeping bags were set up, power-lines installed, antennas erected, and a good supply of discussion material collected. Operating schedules were made, and it was planned to have one person on while one would sleep, eat, etc. Every 6 hours they would change around. Radios, television sets and tape-recorders were set up. Cokes and food were all around. A fence was set up to keep out nosey neighbors and blowers were set up to keep the rigs running cool. This was to be a true test of physical and mental endurance, as well as

^{*}Real Rag Chewer.



This was to be a true test of physical and mental endurance.

a test of the rigs, which consisted of an HE-45A, and 5-element beam at our end; an Ameco TX62 with a Hallicrafters receiver and converter at the other.

We started on August 7, 1966 at 12:00 noon, after weeks of hard work, planning, and expense. The day was hot, and I was at the rig. We had clocks hooked up to tell us when to identify, and also to tell us when our shifts were over. It took quite a while to get into a routine, but we found it was best to eat while on the air (food was within close reach) and either rest or help out when off duty. Near the end the need for sleep hit us strongly, and we were almost always sleeping in the off shift. We were forced to drink cold coffee to keep awake while we were operating. The strain of this undertaking was immense. During the first day or two, we were ready to give up but were saved by the fact that we had planned well to eliminate boredom during the long hours. We watched and discussed TV programs and had running discussions on everything from UFO's to books. We discussed the ARRL, 73, and Mad magazine and even

had one delightful and stirring discussion of *Playboy*. We read each other books and jokes, and even did a book of "brain teasers" to keep alert.

All in all, it was a hard thing to do, and I would not like to do it again. However, things were running well until disaster struck! The receiver part of my HE-45A blew a capacitor while George was transmitting on it. In order to make our claim valid, the QSO had to be continuous, so George was forced to continue the transmission until the receiver could be repaired. I turned the rig over and cut off the power to that section. With safety gloves on I removed the part (still smoking) and went to find a replacement while George continued his monologue. Discovering I had no replacement, and couldn't get one for several hours, we took turns transmitting until a new part was obtained. Seeing that we had gone 70 out of the planned 100 hours, we were lucky that nothing really serious happened, but it sure was close at that!

The hundred hour mark approached, and between lack of sleep, curious neighbors, and untimely trips to the toilet, we were glad to see it arrive at 4:00 PM on August 11. George was at the mike, but together we wearily signed off, glad, and at the same time sad, that our long field day was over. For the rest of our lives we will fondly remember that longest QSO, and if we *must* defend our honor, you can sure bet that we will!

. . . WA3GEV



With safety gloves on, I removed the still smoking part.

The Death of Amateur Radio

After reading the editorial in the July 1967 73 magazine I am in partial agreement. True, CB is drawing almost all of the youngsters interested in radio. But why? Why don't they go into ham radio? Why does CB have much more attraction than amateur radio? I'm sure almost every ham exhibits a rather unfriendly attitude toward CB'ers. But why? Why don't we closely associate with the CB'ers? I am going to suggest a few answers to these important questions.

Several years ago the FCC created the CB band. From that time on, the growth of amateur radio has fallen. Now, if we look at all of the old sales and manufacturer's catalogs, we find a new type of communications mode beginning to gain popularity. This new mode was called SSB. At first the price of the equipment was "in line" with the rest of the AM and CW equipment. The first SSB equipment was rather simple but it soon became more complex. Along with the extra complexities came the extra price. This meant SSB rigs began to cost more than AM/CW rigs. Soon the prices went higher and higher. Also, the complexities began to increase until today few SSB'ers ever repair their own rigs. Fewer yet even think of building. When this happens, the SSB hams become SSB operators which means they are glorified CB'ers.

Now let us take a youngster. He can be a potential ham or a potential CB'er. This youngster will seriously look at ham radio. He will see that he will have to learn the code and theory. He will see that if he gets a novice license he will not be able to use a microphone. The youngster may look at the exorbitantly high prices of the real good SSB rigs. Together these factors can be highly discouraging to the youngster.

Sooner or later the youngster will be exposed to CB. CB has everything ham radio has to offer and more. The youngster can

use a microphone on CB. He can run all the power he wants—even though it is illegal. Running 100 watts to even a kilowatt is a very common occurrence on CB. It is so common that the FCC cannot even try to keep up with it. The most ironic thing about this illegal CB power is that the rigs are old AM ham rigs. The CBers use Valiants, Johnson 500s, Heathkit DX100s, or any high power AM rigs they can get their hands on. They buy these rigs extremely cheap too.

New SSBers dumped their old AM rigs on the market with the result that the CB'ers snatched almost everyone of them up. For instance, I have been trying to get a Johnson ranger for several months at a well known radio store in Milwaukee. My result—nil! Not even one. The Rangers are bought almost instantly by CB'ers. The result is that CB is a hundred times cheaper than ham radio.

On CB there is no testing and no code to learn. The simple \$8 permit fee is nothing to a CB'er. After paying next to nothing for his equipment he can easily afford the extra \$8. On CB there is the excitement present in the very fact that they are breaking the law by running high power and QSOing across the country. The chances that any illegal CB'ers will get caught are a million to one. CB indeed has more attracting power than ham radio. After all, what's so great about paying a kilobuck to go SSB to talk across the country when on CB you can do the same for \$150 or less? If you were a youngster, what choice would you take? Anyone with any brains at all would take CB!

This brings us to the question of the hams disliking the CB'ers. If you really explore the problem, two facts come to mind. One is that the CB'ers are having as much, or more, fun than the hams are, and the CB'ers are doing it cheaper! Two is simply that the hams are jealous of this basic fact!

What can we as hams do to correct this

NOVEMBER 1967

situation? We can and *must* do several things if ham radio is to survive at all! We must stop the flow of the cheap AM equipment. One way or another it will wind up in a CB'ers hands if it is sold to anyone other than another ham. We must not trade in the AM equipment when buying SSB equipment. If the equipment is traded in it quickly winds up in a CB'ers shack. We must keep the old AM equipment at any cost! Then we must push for more stringent rules concerning CB. It is necessary to drastically increase the size of the FCC monitoring and enforcement force. The FCC at present is trying valiantly to stop illegal CB activity but it is already a lost battle unless the FCC monitoring force is increased to 50 or 100 times the present number. This will cost money but why not get the money from the CBers? Increase their fee to \$50 or \$100 a year like all the other commercial users have to pay. After all, CB is a commercial business band! This also might very well prove to be a deterent to stop the illegal operator. A high license fee would keep the "goof-offs" and other trouble makers out of CB while the code and theory exam would keep them out of ham radio.

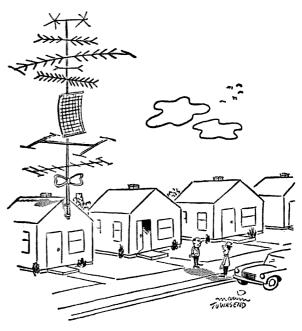
Presuming we could accomplish this, we now would be left with finding something to attract the youngster into ham radio. We need something with enough drawing power to hold this youngster's interest through the code and theory. What do we have that can attract the potential ham to ham radio? Whatever we decide on must be cheap, for as anyone knows, a fifteen or sixteen year old boy cannot muster seven or eight hundred dollars for a SSB rig! Besides, SSB has no attraction worthwhile to the potential ham. It is infinitely complex for him to build and much too costly. So we must look to other things, AM always was an excellent "drawing card." The newcomer could experiment with ultra-modulated AM. This is one facet of ham radio that is sadly neglected. He could try narrow-band FM. This would have high voice quality and excellent signal performance. Experimentation with low power NBFM could produce some startling results! It is true that our satellite communications experiments are interesting, but for the newcomer they are very expensive and require high-priced elaborate equipment. Moonbounce is interesting but also very expensive and complicated.

One of the better attracting devices we had was the low-priced add-on kits avail-

able with AM equipment. I know myself that I spent many countless evenings comparing the various add-on adaptions once offered by the various manufacturers. There was a thrill to amateur radio when the novice took his CW transmitter and added a modulator to it. There was the satisfaction of having accomplished something. This is what drew the youngsters to ham radio and not the factory-built, only mike and antenna needed, SSB rigs. There is no thrill and no excitement to unpacking an SSB rig, plugging it in and hollering CQ like any old CB'er!

If we do not take action to entice the youngsters to ham radio, then ham radio will be doomed to the fate of the passenger pigeon which became extinct because of foolish and stupid human greed! Let us use our brains. Let us create an interesting hobby. SSB is indeed worse than useless in this aspect. There is no excitement, no objective and certainly no goal in SSB. The faster SSB grows, the faster ham radio races to oblivion. Let us stop this trend and divert it to much more useful projects. Let us not be like the murderous hunters who killed the passenger pigeons until they became extinct. If we don't change, in another twenty years there will be no AM, and there will be no SSB simply because there will be no ham radio.

... WA8FVD



"Do you happen to know if there is a ham radio operator living around here?"

Spook Up Your Club's Civic Activities?

October 31st is not the only witching time, but time for hams to bring out their mobiles in the manner of the Huntsville Amateur Radio Club, of Huntsville, Alabama. Each year the club sponsors a Spook Patrol on Halloween night from dusk to midnight in the rocket city.

One purpose of the patrol is to provide extra supervisory protection for the "little spooks" ghosting across darkened city streets in hot pursuit of treats to fill their little bags. Should one fail to see an oncoming car or a hidden obstruction in a strange front yard, or encounter any other hazard in the dark, a mobile unit in radio contact with police and ambulance services gives added protection in case of trouble. A second purpose is discouragement of "older spooks" where innocent pranks might not be so innocent.

Three methods are used to carry out this purpose: first, widespread publicity in newspapers and on local radio stations of the forthcoming spook patrol, with its radioequipped unmarked cars in contact with a fixed station in the city police headquarters. The second method is making the existence of the patrol "highly visible" to potential troublemakers. The mobiles drive through the parking lots of well-known teenage hangouts (hamburger and milkshake drive-ins) at irregular times. To insure that their presence is noted by the youngsters, the hams keep their windows open and receivers at maximum volume. The net control stations operators voice. identifying with K4XXX in the Spook Patrol" is heard by car occupants in the drive-in who turn to watch the mobile unit exit on patrol. (Each operator usually makes a point of getting a hamburger and coffee at the drive-in, leaving the radio turned up while away from the car, presumably so he can hear if he is called. Actually so the youngsters in other cars can

That the young people are "condition-re-

flexed" (as one doctor-ham put it) to the thought that any car they see might be in radio contact with the police is often verified by the youngsters themselves. Frequently they approach a ham's car to tell him of "trouble" (exaggerated or imagined usually) which they think ought to be reported. The ham dutifully radios their report in to satisfy them, and, if it appears worthy of investigation, the report is passed on to the



police desk sergeant or a mobile unit is asked to drive down the street in question.

The third method we use is borrowed from standard police "saturation patrol" techniques. When a report of vandalism in any part of town comes in, all patrols are directed to make one pass through that area on their next round. The youngsters in the neighborhood who see the mobiles get the impression of constant surveillance-and usually go home to watch TV!

When a group of teenagers in a passing

car appears suspicious, the ham notifies the NCS of their route, whereupon they see another ham mobile sitting at an intersection ahead, watching them and with his microphone to his mouth as they go by. One group left a teenage dance to "have some fun" and drove back dejectedly a half-hour later to tell others they saw "those ham patrols everywhere". Actually only two of the cars they spotted were spook patrol members directed into their path by another ham. The rest were figments of their imagination and guilty conscience! A church group trickor-treating-for-UNICEF claimed that they saw "twenty or thirty" in the area their church covered in the campaign. Only five were actually on patrol throughout the city at that time, and none in that part of town! They thought every car with an antenna (including broadcast) was a patrol.

Though a boomtown, Huntsville has never had any serious Holloween disturbance. The Huntsville Amateur Club likes it that wayand urges hams in other cities to follow their example, not only for Halloween, but for any possible civic disturbance such as those which rocked many northern cities this summer.

"It's surprising what the feeling that some

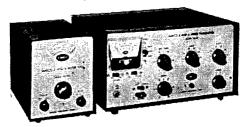
unknown person is watching you in the dark will do to young people bent on mischief," commented one member of the club. "Most of the kids don't even intend any harm, they just let things get out of hand due to youthful bad judgment when suddenly faced with temptation with no one around to see. We like to think that we are their conscience. We aren't everywhere, but we are glad they think so-and stay out of trouble.'

A second and third purpose of the Huntsville Amateur Radio Club's Spook Patrol is training of its members in controlled mobile emergency operations—and good public relations in the favorable publicity given amateur radio as a public service by the press and local broadcast stations. These last two reasons make the project worthwhile even in cities where there is no Halloween problem making such additional protection necessary.

In Huntsville, where tornadoes are an annual threat and the nearby Redstone Arsenal missles complex a prime military target, the Huntsville hams consider training in mobile communications an important part of their club responsibility. The annual Spook Patrol aids in this training.

. . . **K4HK**D

NEW VFO FOR TX-62 or any other VHF TRANSMITTER



NEW AMECO VFO FOR 6, 2 & 11/4 METERS

The new Ameco VFO-621 Is a companion unit designed to operate with the Ameco TX-62. It can also be used with any other commercial 6, 2, or 11/2 meter transmitter.

Because it uses a transistorized oscillator circuit, it is extremely stable. An amplifier stage provides high output at 24-26 MC. The VFO includes a built-in solid state Zener diode regulated AC power supply.

This new VFO is truly an exceptional performer at Model VFO-621 a very low price \$59.95 net.

The NEW (



In response to the demand for an inexpensive compact VHF transmitter, Ameco has brought out its new 2 and 6 meter transmitter. It is easy to tune because all circuits up to the final are broadbanded. no other transmitter like it on the market!

SPECIFICATIONS AND FEATURES
Power input to final: 75W. CW, 75W. peak

on phone. Tube lineup: 6GK6—osc., tripler, 6GK6
doubler, 7868 tripler (on 2 meters)
7984-Final. 12AX7 and 6GK6 modulator.
Crystal-controlled or external VFO. Crystals

used are inexpensive 8 Mc type.

weed are inexpensive 8 Mc type.

Meter reads final cathode current, final grid current and RF output.

Solid state power supply.

Mike/key jack and crystal socket on front panel. Push-to-talk mike jack.

Potentiometer type drive control, Audio gain control.

Additional connections in rear for key and relay. Model TX-62 Wired and Tested only \$149.95

AMECO EQUIPMENT CORP.

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Simple Modifications for the HW-12, 22, and 32

Recent articles have appeared in various publications telling how to put these transceivers on CW, and retune for the CW portion of the band. These have been good as far as they go, but they leave out the convenience of bandswitching. I have the 80meter transceiver, modified with the Dynalab Deluxe conversion kit, and have further modified it as described here. The original purpose of the modification was to enable me to work the European phone segment of 80, while at the same time, maintaining immediate capability to get onto the local MARS frequency of 3996.5 kHz. The answer was quite simple: parallel C-130/C-131A with a fixed 60 pF and a 7-45 pF ceramic variable.

Do not run directly to ground, but instead through a switch. For those who wish to make a no-holes modification as I originally did, and for those who do not have the calibrator installed, the leads running to the calibrate switch may be removed and taped. One switch lead is then run to ground, the other to the end of the added capacitors. Operation is simple: for normal operation (on 80) leave the calibrator switch in; for the lower coverage, pull it out.

The trimmer (7-45) may be adjusted, and in doing so, you will find that you have lowered the frequency approximately 200 kHz. I imagine a more accurate means could be found, but this was satisfactory for my purposes once I established that 4.0 MHz would be 3.8 MHz on the dial in the lower position. For those persons having the Dynalab conversion (or the straight 40 and 20 meter transceivers) throwing in the added capacitance will raise the frequency 200 kHz. This is fine for those hams who want to work the 14.405 and 14.505 MARS frequencies, but for normal operation a somewhat different approach must be tried. In this case, after

installing the additional capacitors, pull the switch to put them into the circuit, then recalibrate in the normal manner, which is now high. Pushing the calibrate switch in will then lower the frequency putting you in the 40-20 meter CW band. The same could be accomplished with a subminiature toggle switch which will blend nicely into the cabinet. This modification (addition of capacitors) is easily accomplished above chassis by using one of the printed circuit mounting screws run through the hole on the trimmer case.

Other simple, but useful, modification I have installed is a three-inch round internal speaker, mounted on the right side of the case next to the top. Use a good grade speaker because the thin paper in the economy models will dry out and start to rattle quickly. A small vernier dial which was added to the panel is an excellent aid in tuning. especially when mobile. I have also added a stereo type jack on the front panel, and I can use a head-set-boom mike by simply plugging it in. Lastly, I have added sideband selector lights to go along with the Dynalab kit. Wiring is run through the unused side of the sideband selector switch and an added rotary switch section on the added bandswitch (this is necessary because the sideband switches on the various bands). To complete my rig, I am using a Knight Audio Compressor which gives an added 3 dB gain on most contacts. From my location at Ramstein Air Base, Kaiserslautern, Germany, mobile, I have worked as far as Australia and Alaska on twenty meters using the modified transceiver, HP-13 power supply and Hustler antenna. Hope you all have as much fun with your rig as I do mine-at their low cost, one can easily afford to experiment.

... DL4XO/W3BQE

Project Milk Wagon

You two can form a club.

When I first moved to the small village of Dorchester two years ago, there was only one other active ham; now we have five and some others who are working towards their "tickets". We also have a communications trailer which is probably the only one of its kind in the country.

It all started when I arrived and met the other ham. He said, "Well, now that there are two of us we can form a club. I'll be President and you can be Secretary." To make things confusing we both have the same surname, although unrelated. We have just about given up denying that we are brothers.

For a while it was a good gag; each time we met was, of course, a club meeting with 100% of the membership present. However, last year we decided to make our debut with a station for Field Day. A local campground operator volunteered the use of his site, and equipment was begged or borrowed in a hurry. A 40-foot aluminum ladder was used to raise our inverted vee and I can recommend this as a useful portable mast. Guy it at the twenty foot level, climb up and attach your antennas and top guys and push it up from there. It is easily transported on top of a car. My tent trailer was used for operating and sleeping quarters, and we put up a reasonable score as a one-band station. One of our operators, rather bushed after a long session, was heard to say to a W9, "You are 6 and 9 Ontario section OM" to which the W9 replied, "That's the best report I've had in 20 years of ham radio!"

Our fame must have spread because when

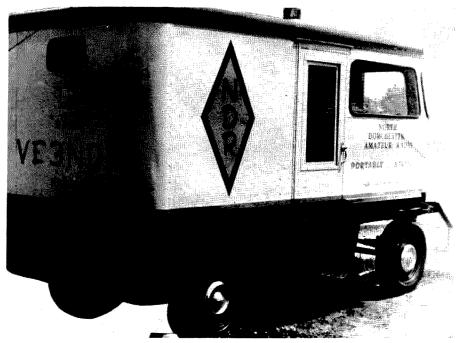
the annual parade and fall fair came round we were asked to assist the parade marshalls by providing mobile communication. We figured this to be a good chance to boost ham radio in the area and arranged to have a station operating in the fairground all day. The parade went well with the aid of two friends from a nearby city, and the four mobile "Twoers' kept things moving and parade officials informed. Although our station at the fair was cramped in a corner behind prize bails of hay, we had many enquiries. Also, we managed to hook up our local member of parliment with the minister of agriculture in Ottawa. Good for publicity!

As any ham knows we are always meeting people who say, "I have always wanted to be a ham; how do I go about it". We had



After six months of searching, we located an old horse-drawn milk cart that we could convert to a communications trailer.

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The North Dorchester Amateur Radio Club's communications van. Converted from an old horse-drawn milk truck, this trailer serves as field day headquarters and emergency operating station.

already decided that if we were going to have a club we needed more than two members. Since we were the only two hams in the village, there was only one way to get members and that was to 'grow' our own. At the fair we handed out leaflets announcing a class to start in my home the following week. On the following Wednesday w were pleasantly surprised to find that te people showed up, including two YL's. It was a good thing my XYL was out on Wednesday evenings! Of course, as was expected, the group dwindled after a few weeks, leaving the dedicated group who stayed with us all winter. On the occasion when our first student got his ticket, his XYL baked a special chocolate cake which he brought to the club. The second to get his ticket was a 15-year-old high school student of whom we are especially proud (15 is the minimum age for a license in Canada). Chris is very keen and hopes to start a high school club in the fall. We look forward to helping with this project and already have more enquiries from wouldbe hams for another class.

You will have gathered from other articles in 73 that 1967 is a big year for Canada. Last fall when our class was moving along nicely we heard a lot about other clubs running centennial projects. This seemed to be out of the question with our small group and limited funds. However, our president, Norm, had the great idea of building a communications trailer. This seemed ridicu-

lous until he pointed out that there must be a bunch of old horse-drawn milk wagons around which could be picked up cheaply and converted.

It wasn't so long ago that some country dairies switched to trucks. Being a traveling man, I was nominated to look for one. Suddenly there was not a milk wagon to be found. I got a little tired of calling on dairies and asking everyone I met, "Do you know where I can find a milk wagon?" Of course the reason had to be explained each time.

Spring rolled around and finally, after a six months search, my enquiries paid off. I was told I could find one in a certain farmyard. When I rolled up, I found ten of them in all shapes and conditions. The following weekend the gang went out and we picked out the best one for our purpose. The horse shafts were still in place but the dairy loaned us a hitch and I towed it home.

I was pleased to find that it was a well-sprung vehicle and towed beautifully. I also got a kick out of the stares of my neighbors as I towed it up the village street.

After being a ham for some time you get used to the neighbours saying, "What is that crazy nut up to now?"

Getting the wagon home was just the beginning; there were windows to be fixed, the doors needed replacing and of course the interior had to be fixed up. Finally, a good paint job and lettering. The shafts had to be replaced by a trailer hitch as we had no intention of using a horse!



VE3DNR on a field day site. A 40-foot aluminum ladder is used as an antenna mast.

Fortunately, our group was growing, and some useful people were involved, so we were able to get supplies at a minimum cost. Also, we were getting them trained in the good old ham art of scrounging. There was still some expense of course, and a draw was run locally to raise funds. I am glad to report that we are now 'in the clear'.

The deadline for getting the trailer ready was June 24. This turned out to be, not only Field Day, but the day for a big centennial parade and shindigs at the fair ground. It looked like a big weekend for us as we were once again asked to marshall the parade. The trailer was entered in the parade so we got to work on the conversion and were hard at it right up to the day. There was not time to finish the inside but we managed to install a bench and chairs for field day operations. The important thing was that the outside was fin-

ished and made a smart entry in the parade.

Marshalling went off without a hitch, and the trailer was an attraction at the fair-grounds which helped us to sell tickets for our draw. At 3 PM we drew the winning tickets and pulled out, heading for the campground to start field day. Everything was set up and working by 5 PM for a good start. The campground owner is now one of our members so we have a good pitch there with a pool and snack bar. Sitting in our trailer was a real pleasure after the usual tent-type operation.

We had some equipment problems but the trailer had a good workout and gave us a chance to find out what else had to be done. The main item is a reliable power supply which can be kept in the trailer so that we can take off in a moment in case of emergency. Wiring and meters will be installed as well as mobile antennas, in case the ladder cannot be used. Bunks and a table will be fixed in the rear half. The front end is used as the operating position, and three operators can sit side by side. Several club members have trailer hitches so that anyone of them could pick up the trailer and take it to an emergency location. We will also use the trailer for mobile meets and other outings so that members will get plenty of practice.

Incidentally, our membership is now eight. How many clubs can say that they have quadrupled their membership in one vear? We also have our own callsign, 3C3NDR (North Dorchester Radio Club). In the first year much has been accomplished. The only drawback has been that Norm and I have been too busy to do much hamming. Perhaps now we can let the new members take over and get back on the air. Two main conclusions have been reached; one is that recruiting and training new hams is a rewarding experience and renews interest in the hobby. The other is that, a project like the milk wagon keeps members busy and maintains their interest in the club. We have met every week for almost a year but have never had a formal business meeting or speaker. We have just had too much to do and talk about.

Recent figures show that not enough new people are coming into the hobby, so fellows, why not get out there and do a selling job? You don't have to be a big group with large funds. Remember: you two can form a club!

... VE3FKY

The Drake MN-4 Antenna Matching Network

Almost all of the amateur transmitters today use a pi-network tank circuit which is designed to work into a 50-ohm resistive load with an SWR of less than 2:1. This resistive load can only be achieved with a resonant antenna. For the ham who is only interested in working on one band this doesn't pose too much of a problem since he usually has space for at least one antenna. However, if he wants to work on more than one band, and preserve the 50-ohm load to his transmitter, he has to use some type of antenna tuning unit or matching network.

The new Drake MN-4 Antenna Matching Network takes care of all these problems very nicely. It will provide an optimum match with multi-band antennas, measure the feedline SWR and reduce the SWR at the transmitter to 1:1. It will match the transmitter output to a linear amplifier which does not have a 50-ohm input impedance. In addition, it monitors transmitter power output in watts directly and continuously. Since it attenuates the second harmonic of the transmitter from 25 to 35 dB, it may eliminate the need for a low-pass TVI filter.

These are just a few of the jobs for which the MN-4 is tailor-made. It will also match the transmitter to an antenna across a complete amateur band; permit "off-the-air" transmitter tuning and antenna matching at low power using a dummy load; or, help localize antenna problems by comparing transmitter output into the antenna with the output into a dummy load. Also, it will "store" the loading adjustment for the transmitter when switching adjustment for the transmitter when switching from barefoot to linear amplifier operation because the matching network is bypassed in the direct position of the bandswitch.

The Drake MN-4 consists essentially of a wideband pi-network with a series capacitor for tuning out any reactive component of antenna impedance. The input side of the network consists of a set of fixed capacitors which are selected by the bandswitch—not unlike the pi-network in most transmitters.

The pi-network inductance has taps for each band with a special coil for ten meters. Two positions for the 3.5 MHz band—80A and 80B—insure sufficient tuning range to cover the entire band.

In addition to selecting the band in use, the bandswitch may be used for direct or alternate operation. In the direct position, as we previously noted, the matching network is bypassed. In the alternate position, the matching network is removed from the circuit and the rf is connected to the alternate coaxial socket on the back of the unit. This socket is made to order for a dummy load, and is very useful for initial transmitter tuning.

The special wattmeter which is built into the MN-4 makes tuning the unit a real snap. In most antenna tuning units, the SWR indicator is of the "monimatch" variety. One of the big disadvantages of this type of SWR pickup unit is that it is sensitive to frequency changes—being more sensitive on the high frequencies than the low. Not so with the wattmeter in the MN-4. In this wattmeter the pickup unit consists of a specially wound toroid transformer with no significant differences in sensitivity in the frequencies of interest—3.5 to 29.5 MHz. Thus you can tune the unit for minimum SWR without continuously juggling the sensitivity control.

With an SWR meter that is not frequency sensitive, it is a relatively simple matter to tune up the MN-4. All you have to do is vary the resistance tuning knob for an SWR dip, turn the reactance tuning slightly to bring the SWR upscale and tune the resistance knob for another dip. If the second dip is downscale from the first, you're tuning in the right direction and should continue to alternately tune the resistance and reactance controls until a minimum SWR indication is obtained.

If the second dip reads higher on the scale than the first dip, you're tuning the reactance knob in the wrong direction. Turn it in the opposite direction and dip with the resistance control until you obtain a minimum SWR indication on the meter. If the

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Drake MN-4 Specifications

Frequency range:

3.5-4.0 MHz, 7.0-7.3 MHz, 14.0-14.35 MHz 21.0-21.45

Input impedance:

Load impedance:

Power capability:

Insertion loss:

MHz, 28.0-29.5 MHz. 50 ohms resistive. 50-ohm coax with SWR of

5:1 or less (any impedance angle). 75-ohm coax with lower SWR may be used.

200 watts continuous. 0.5 dB or less on each band

after tuning. Built-in wattmeter:

Reads forward

watts or SWR.

Wattmeter accuracy: $\pm 5\%$ of reading +2 watts. 51/2x103/4x81/2 inches.

\$69.95.

Size: Price:

*Although the MN-4 is rated at 200 watts, Drake will be coming out with the MN-2000 in a couple of months. This unit will be rated for the full legal limit.

dips are so low in magnitude that it's difficult to tell whether one dip is lower than another, you can increase the meter sensitivity. With the added sensitivity it may not be possible to dip the meter to zero, but any residual reading will, in most cases, represent less than 0.1 watt.

I was surprised, and pleased, to find that you can tune up the MN-4 in less time than it takes to talk about it! With most antenna tuners it's a matter of juggling the controls and transmitter loading and SWR sensitivity. Not with the MN-4-in about 30 seconds you can tune it up from scratch. And, when you move from one end of the band to the other it's only a matter of seconds to get the SWR back down to 1:1 again.

Remember though, the matching network only matches your transmitter to the transmission line. The mismatch at the antenna still exists. Although you can get some rf into the antenna, it won't perform as well as an antenna which is resonant.

A set of tuning curves which is provided in the instruction manual show the resistance and reactance control settings versus load impedance. These curves may be used to determine the approximate load impedance of the antenna you're using. Or, if you already know the load impedance of your antenna, the curves may be used for setting up the initial control positions on the MN-4.

For the amateur who is limited to one antenna, and wants to work more than one band, the Drake MN-4 Antenna Matching Network is a natural. Not only is it simple and quick to tune, it will match a wide variety of sky wires. And, even if you have the space, the idea of only one antenna should appeal to the XYL.

... W1DTY



The Omega-t Antenna Noise Bridge



If you have to adjust any antenna matching sections, determine antenna resonance frequencies or cut coaxial lines ¼ or ½ wavelength long, the new Omega-t* Antenna Noise Bridge is one of the slickest little gadgets around. When you're trying to prune an antenna or tune a gamma match with an ordinary antenna impedance bridge and griddip oscillator, you almost need five hands. Not so with the TE-7-01 Antenna Noise Bridge—it will fit in the palm of your hand and the only auxiliary equipment you need is a receiver.

Since the noise bridge covers the frequency range from 1 to 100 MHz, and will measure impedances from about 10 to 100 ohms, it is ideal for the 50-ohm systems used by most hams. To tune up an antenna all you have to do is connect the antenna and receiver to the bridge terminals and set the dial

*Omega-t Systems Inc., 516 W. Beltline Road, Richardson, Texas 75080.

near 50 ohms. Then you tune the receiver over the frequency range for which the antenna was designed looking for a null in the noise output of the noise bridge. Since noise output is more than sufficient to mask any received signals, false indications are eliminated. When there is a noise null on your receiver, either in audio level or minimum S-meter reading, the resonant frequency of the antenna may be read off the dial of the receiver.

After the resonant frequency has been determined, the noise bridge dial is adjusted for best noise null. The antenna impedance may be read directly from the dial. When the noise null is found, the potentiometer (impedance dial on the front of the bridge) may sound scratchy and noisy. This is because of the high resolution capability of the device. The balanced-bridge condition represents a ratio greater than 30 dB and measurement resolution is a small fraction of an ohm.

Therefore, slight movements of the dial cause a large change in the noise null level.

The Antenna Noise Bridge may also be used to determine the electrical length of coaxial line—either one-half or one-quarter wavelength long (or multiples thereof). An antenna-matching system may be adjusted to the proper impedance with the noise bridge (after the antenna is tuned to the desired resonant frequency) by alternately adjusting the match and the noise bridge. Because of the effects of coaxial-line length this should be done with the noise bridge connected directly across the antenna terminals. However, if a coaxial line must be used, it should be one-half wavelength long or a multiple thereof.

The secret to the operation of the Omega-t Antenna Noise Bridge is the special quadrafilar wound toroid shown in Fig. 1. On one side of thos toroid is the wideband noise generator; the antenna, receiver and calibrated potentiometer are connected to the other winding. When the noise across the resistance arm equals the noise across the antenna, the bridge is balanced and minimum noise is applied to the receiver.

The wideband noise generator is a circuit designed specifically for this job. The noise source itself is a reverse biased diode—especially selected for wideband noise output. The noise is amplified and applied to the quadrafilar transformer through a three-transistor circuit. The design is such that the noise is balanced across the generator side

of the transformer.

One of the big advantages of the Antenna Noise Bridge, of course, is its size and the speed with which impedance measurements can be made. This applies to any antenna that you may use—whether it is a beam, a dipole, a quad, whip, long wire, or random length wire with an antenna tuner. The only limitation is the frequency and impedance range of the unit. For most hams using 50-ohm coax this should pose no problem.

There are several other jobs that you can do very simply with the noise bridge. If, for example, you want to know what frequency range you must operate in to limit your SWR to less than 2:1, all you have to do is run some impedance points from one end of the band to the other. For an SWR less than 2:1, your upper and lower band limits will be determined by the point where the impedance indicated by the bridge is less than 25-ohms or more than 100-ohms. For an SWR

Omega-t TE 7-01 Specifications

Frequency range:
Impedance range:

Associated equipment required:

Signal level:

Circuit:

Systems which may be tested:

Power supply:

1 to 100 MHz.

0 to 100 ohms (for nominal 50-ohm coaxial systems). Receiver which tunes frequency of interest. S-meter useful but not required.

Masks normal received signals to eliminate false indications.

Quadrafilar wound bridge transformer, 3 transistors, 1 special diode.

Antennas—quads, beams, dipoles, whips, long wires, random length wires with matching networks. Coaxial matching systems — series,

shunt, gamma. 9-volt transistor radio bat-

tery. $2\frac{1}{4}x3\frac{1}{4}x3$ inches.

2 14 x 3 14 x 3 11 to \$24.95.

Size: Price:

of 1.5:1 or less, your points would be 33 and 75 ohms.

Another application for the Antenna Noise Bridge is checking baluns. Have you ever wondered if that balun really represented a step down of 4:1 (or 1:1)? Just connect a 200-ohm resistor across the output terminals of the balun (50 ohms for 1:1 baluns) and measure the input impedance with the bridge. You can also check the balun to see what frequency it is cut for—at frequencies very far off its center frequency it won't provide the desired transformation ratio. A similar check can be run on the broadband baluns that are currently on the market. Since the Antenna Noise Bridge may be used

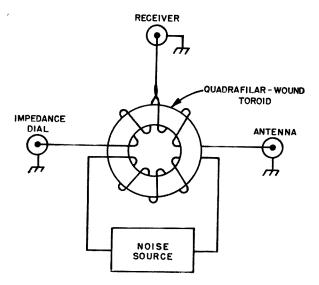


Fig. 1. Diagram of the Omega-t Antenna Noise Bridge. A wideband noise source is connected across one side of a balanced, quadrafilar wound transformer; the receiver, antenna and calibrated potentiometer are connected across the other.

from 1 to 100 MHz, it is ideal for checking wideband systems.

It may also be used for checking the resonant frequencies of trap dipoles and beams. When checking a properly adjusted three-band beam, for example, you will find three separate and distinct resonant points. If the resonant points aren't in the parts of the band where you want to operate, it's a simple operation with the antenna noise bridge to adjust the traps right on the money.

After plodding along with an old homebrew antenna impedance bridge excited by a grid-dip oscillator for a good many years, the Antenna Noise Bridge was a welcome change. For versatility, simplicity, and use, it's going to be pretty hard to beat. If you are planning on doing any antenna work in the near future, give yourself a break—the time you save will be well worth the small investment for one of the handiest gadgets I've seen in a long time—the Antenna Noise Bridge.

. . . WIDTY

RTTY Hints

For some unknown reason, military surplus Model 15 page printers more often than not come without paper spindles. I made a more-than-adequate substitute by wheedling the chemistry department out of two 1" tapered rubber stoppers with a center hole. When pushed on a shaft made of any rod material that will fit the machine, the stoppers do a good job of wedging the paper anywhere on the shaft.

The problem of re-inking faint ribbons is easily solved. Actually, no "re-inking" is necessary: very seldom does a ribbon, either TTY or typewriter, lose its ink—the ink dries out. Therefore, it is a simple matter to reactivate it with ordinary 3-in-1 oil. Simply remove ribbon (wound fully on one spool) and the take-up spool. Wind a turn or two on the take-up spool. Unroll about six inches of ribbon from the full spool and put a thin line of oil on the first three inches. Roll up the six inches. You will notice the oil seeping through from the oiled ribbon on the unoiled part that is rolled on top of it. Follow this procedure until the ribbon has been fully wound on the take-up spool. Let the spool set at least overnight so that the oil can be absorbed evenly throughout the ribbon.

. . . Horton Presley KØHVK



Comdel CSP-11 Speech Compressor



Ops interested in being on top of the heap, or in getting a few more dB output on VHF without the usual distortion, will be interested in the new Comdel Speech Processor. In tests at W2NSD/1 and K1RA, reports with the CSP-11 were somewhere around 3 dB higher than without it and with a noticeably louder signal.

Actually, the CSP-11 is designed for use in any system that uses a microphone for voice transmission, and results in useful talkpower gain, as well as in a concentration of the power in the frequency range that gives the best intellegibility. This has the effect of narrowing the transmitted signal width—a highly desirable feature in SSB work, producing, in effect, a gain of about 10 dB, and having little effect on the power supply because it is actually the same power but more concentrated.

The Comdel is interesting from an engineering standpoint. The big problem with speech clipping is to avoid the distortion that usually accompanies it, and this is a serious problem in sideband operation. Comdel came up with a tricky solution: basically they have built a complete sideband generator which changes the audio input to SSB, clips it and

demodulates it back to audio. The undesirable clipping products are lost in the process and you come out with nice, clean, compressed speech.

In the CSP 11, the original audio frequency spectrum, centered around 1.5 kHz for the human voice, is translated to a much higher center frequency. In the audio range, human speech represents almost a 10:1 range—from 300 to 3000 Hz. This is a little more than three octaves. When the speech is translated to a higher frequency, its bandwidth represents much less than an octave, and it is somewhat easier to process with minimum distortion.

Peak limiting the translated signal produces the usual harmonics, but they are easily filtered out, since they are considerably removed in frequency. The amplitude-limited

Comdel CSP 11 Specifications

Frequency response:

Input impedance:
Minimum output load:
Signal to noise ratio
at limiting point:
Input level at
limiting point:
Output level at
limiting point:
Power requirements:
Battery life:
Size and weight:

Price:

500 to 2500 Hz at —3 dB points.

0.5 megohm. 5000 ohms. 36 dB minimum.

10 mV peak.

50 mV peak.

9 Vdc at 18 mA. 300 hours. $5\frac{1}{2}$ x $3\frac{1}{4}$ x $7\frac{1}{2}$ inches; 32 oz. \$120.00 postpaid.

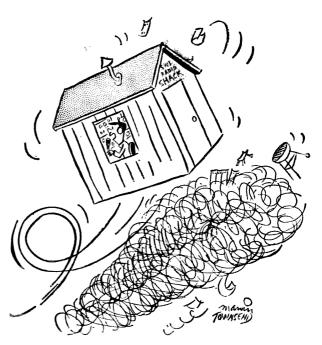
^{*}Comdel Inc., Beverly Airport, Beverly, Massachusetts 01915.

spectrum is then translated back to its original position. This results in peak-limited audio signals free of harmonic distortion.

The Comdel Speech Compressor is completely transistorized and requires a minimum power supply-9 Vdc at 18 mA. Provision is made for six 1.5 volt "D" cells connected in series. However, power may be obtained from an external source or powered in 12-volt mobile systems without any external components. The unit is designed to be used with fairly insensitive, high-impedance microphones having a peak output of 25 mV on voice peaks. Most communication type microphones give considerably more output, necessitating a reduction of the front panel level control.

When the Comdel CSP 11 is used, the resultant output of your transmitter is no higher on peaks and there is no apparent broadening of the peak spikes, but the envelope seems to be a bit fuller down the slopes.

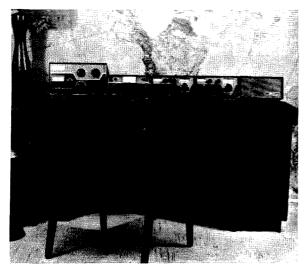
There were a few reports that the voice was a bit more natural with the unit out of the circuit, but that the signal was clean and usefully louder with it in. Depends on what is important to you . . . sounding like the star you are, or working the DX a few con-



"Hold it, Gus! I think I've just gone mobile!"

tacts earlier in the pile-ups. At \$120.00, plus batteries, or with a 12-Vdc supply, this is an economical way to get a nice boost in output. . . . W2NSD/1 & K1RA

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Six Hours With *Blintz' DXpedition 4X8HW

This DXpedition was already in the planning on the 6th of June. From that date, we knew that we would be operating a 4X something, but at that time we did not know exactly when.

From Wednesday evening on the 7th, we had chosen our place of operation: the "Old City of Jerusalem." Since there were operating restrictions, we had to wait to get permission to operate until the last minute.

Then the day came. In the morning, we received notice by mail that all amateur radio stations may resume their normal activities. We immediately set about getting a Jerusalem permit. Before we knew it, we were given the call 4X8HW. Operators of the station were 4X4WH David, A1 WB6AXG/4X (who's Swan 350 did all of the shouting) and 4X4TP, who operated the same station as 4X8TP part of the time.

We had planned to be on the air at 1500 GMT, but due to a flat tire we were off to

a late start. We missed an appointment with an army official who was to arrange for a place to operate, so we were on our own from then on. There we were in the redeemed former Heshemite Kingdom of Jordan (may it rest in peace) looking for a spot to operate.

Our first try for a place was the Hebrew University at Mt. Scopus. We managed to scrape up an old generator at the University, but it was too weak and in service for only a few hours during the night. Our next stop was across the hill . . . the ex-Jordanian hospital, Augusta Victoria. Here we received a flat "no", and the only help we received was a lift out the door.

Due to the late hour, we decided to give it one more try, and if it didn't work we would return to Tel-Aviv and forget the whole thing. Luckily this was it. The manager of an old hotel let us make use of his electricity. The only problem was that we



Just to show we were really there!

98 73 MAGAZINE



Our biggest problem was having to operate from the car to avoid disturbing the hotel quests.

had to operate from the car so we wouldn't disturb anyone in the hotel.

Early in the evening we made our first stateside contact, but the band closed up on us completely for about another hour and a half. After that it was all "go" until about six in the morning. In the middle of it, K6YRA managed to break through the east coast ORM followed by five other Californians. Unfortunately no sevens were heard, and besides Ws we worked only about 25 other stations.

When the band closed, we packed up shop and went for a little trip through Bethlehem and Rammallah and back home. We would have staved longer, except for Al's exam in Organic Chemistry, and Dave's girlfriend who had to get back to the army. She was brought along to help with morale problems (Dave's) late at night.

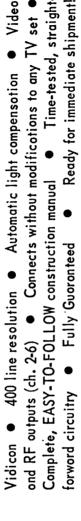
We had planned to go out again, but the Swan power supply (serial no. M110702) and Swan VOX unit were stolen along with a Knight P-15 SWR meter. Because of this, future expeditions will not be possible until the equipment is found or until some kindhearted person will replace it for us.

If we get the equipment, your roving arabs will be going to 4X8 again, and also 4X6, the Gaza strip and Sinai.

. . . 4X4WH and WB6AXG/4X

*For the enlightment of the uninformed, a Blintz is a Jewish Creppes Suzette filled with either fruit or cheese, fried in butter and slathered with sour cream. Drool . .

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Bouvet Island

All the while we were on Bouvet Island, the ice breaker was slowly circling the island, taking pictures and plotting a depth chart of the ocean in the immediate area around the island. They were down there with the idea of looking into the possibilities of finding a place on the island to install a weather station. I am not sure of the exact size of Bouvet island, but I would estimate it to be about 5 miles on each side, and it is more or less square in shape. The wind seemed to blow all the time from the southeast, and that's where the cold weather came from I suppose. Why anyone would want to possess such a place on this earth is beyond me, unless someday the earth shifts on its axis and Bouvet Island is shifted further north making it a habitable place to live.

Radio conditions were fine almost all the time. The bands went out about 3 AM and would start to open again around 6 AM. But all signals had that far away sound most of the time, with the exception of stations in the southern part of Africa, which was only around 1,500 miles away, making them just the right distance to get their first hop reflection from the Heavyside layer. Oh yes, you should have heard those S-9+ signals from ZS2MI over on Marion Island and the same with signals from the VP8's over on the Falklands, South Georgia, South Shetlands, and the signals from the boys down on Antarctica were "out of this world" -solid S-9+ everytime I heard them.

It's funny how your source of QRM shifts as you travel around in the world. On Bouvet it was the ZS stations and a few VP's and the others on Antarctica. But since there were not too many of these, it was no bother to me unless they were within a few kHz of stations I was in QSO with. Bouvet was just about the most QRM-free spot I have even been, I would say. The W/K's, most of the time, were up around S-8 when the band was open, and it stayed open to W's

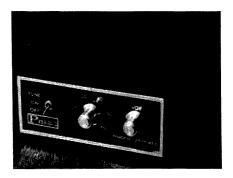
almost all the time. The W's actually were the ORM makers!

The most difficult places to work were Australia and New Zealand, not because of the distance, but because they were fairly well shielded from the point where I was located on Bouvet. How any VK or ZL ever got a signal through to me seems impossible, since they were on the other side of the straight up and down cliffs. Possibly it was some kind of reflection or back scatter, but I did manage to work a few of them. To the rest, I say, "I'm sorry—but I tried my best to work everyone I could hear."

Each day I had a number of schedules with the boat as it circled the island doing survey work. Just how many times they made this circuit I never did find out, I think they made each trip around a little further out so they could have a good depth chart of the waters around Bouvet in case they ever wanted to return there at some future date. The longer they stayed the better it suited me.

At the end of the 4th day they told us to be ready to depart the next morning around 10 o'clock. That night I stayed up and never did get in the sack. I did manage to have a few QSO's on 80 meters after all the other bands went dead. But the vertical I used was not made for 80 meters and the SWR was something around 10:1 as near as I could measure. Which made for not too good efficiency on that band and when you consider I was only barefoot all the time, I guess I did OK. The next morning about 9 o'clock we had our last OSO from Bouvet Island. My stay at Bouvet was not as long as I would have liked it to be, but at least I got there and made almost 5,000 fellows happy by giving them another "new one." It seems absolutely impossible for anyone to go there unless they come across another "ice breaker" to get them there. To charter one of these monsters is out of the question with the normal contributions you receive from the fellows back home. You

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could probably charter one of these boats but considering the cost of chartering a much smaller boat, I would think it would be something like \$10,000 per day. The price continues while you are on the island operating. So by doing a little quick figuring, let's say it takes two days from Capetown to get there, plus five days on the island and then 2 days more back to Capetown you will have tied up the ship for seven days—\$70,000. We all know that a ham DXpedition can't afford to spend this kind of money just to put one DX spot on the air.

After a lot of rushing around taking down the tent, taking the vertical down and separating all the sections so it could be put back into the waterproof bag, wrapping up the power plant, all the suitcases, etc. took about one hour. We just made it by the time the small boat came up for us. After slipping all over the frozen rocks and loading the lifeboat as it went up and down with the slow-moving ice floes, we jumped into the boat and after another hours trip we arrived back at the ice breaker. The derrick-like crane lifted us back on to the ship and The Bouvet Island DXpedition was over. The captain of the ice breaker decided to

head south after LH4 land, possibly even going down to the South African weather station on Antarctica. While the ship banged away at the ice floes, I got busy and put up a long wire for some /MM operation.

While we were on our way, I wanted to keep the boys informed of our progress. My own opinion of Bouvet Island—it's a miserable, cold, damp, Godforsaken place and not fit for humans. My last view of the island, some 10 or 15 miles away, was a big white chunk of ice sitting on top of the water. I got going on the air late that afternoon and the first 3 QSO's I had asked me, "when was I going back to Bouvet." They said they had missed me! I told them not to hold their breath until I returned. Of course, if I had the chance, I would go there again tomorrow.

The further south we went, the heavier and thicker the ice pack became. It took a lot of backing up and full steam ahead to break up the ice for the ship to get through. An ice breaker works like this: the bow of the ship protruded some distance out from the ship at a very slight angle. Up under the bow the bottom of the ship had a rather sharp edge and when the ship wanted to get through the solidly



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600	1	.30	T	1.00	1	1.20	1.80
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frozen ice pack it would back away from the ice and then full steam ahead. The ship would slide up on the ice and the sheer weight of the boat plus the sharp edge underside would sort of break and cut through the ice. When the ice broke there would be a sharp snap, then a big splash as the bottom of the boat hit the water up under the ice. Then it would back away and steam ahead into the solid ice again. This was repeated over and over, gradually bringing us closer to Antarctica.

After about 3 days and nights of this maneuvering we were finally some 200 or 300 miles south of Bouvet and all the time the ice pack was getting thicker and the weather getting much colder. It was rough going and very slow forward motion too. At the rate we were going, it's hard to say how long it would have taken us to get to the continent of Antarctica. I never did get the chance to find out because one time we banged into the ice and then the water started to freeze in back of the ship, making it difficult to back up for the next banging ahead job. The Captain decided, right then and there, that it was time to stop going south since the ice breaker might get frozen

into the ice pack if the weather and water got a bit colder. After a lot of back and forth effort the ship was finally turned around and we headed straight for Capetown, South Africa.

All this time I was on the air except when I was out on deck watching all the action that was taking place breaking through the ice pack. Getting back to Capetown took three days and nights. After two days we departed from the ice floes. The ice pack starts at a sharply defined line and when you leave this line you only see a few pieces of floating ice here and there and an occasional iceberg.

Leaving the ice floes, we came into what I call the "whale waters." Many of them were seen, usually in herds it seemed to me. Sometimes as many as 25 or 30 would be seen with their water spouts spouting water. When we were close enough I could actually hear them "blow." I suppose that's where the expression "there she blows" comes from. Many times the ship would get right into the middle of a "herd" of these whales and most of them would dive straight down, with that big tail flipper sticking straight up. When you consider the size of these animals,



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it's hard to believe how well they can get around in the water. Nothing sluggish about them that I noticed; they had plenty of life. The afternoon of the 3rd day, the big mountains just out of Capetown could be seen. Suddenly we were back in civilization again—and it did seem good to be back.

There on the docks were my friends Jack and Marge (ZSIOU and ZS1RM) waiting for me. They both pitched in and helped me unload everything and we went to their home some 25 miles out of the city at a beachside place called the Strand. As usual, they had their "Fridge" full of Cokes especially for me. Their fruit season had come in while I was away, so they were loaded with every kind of fruit you could imagine. Peaches, grapes, figs, plums, apples, melons and some other fruits I had never seen before. Since my stay was a short one, I didn't have time to really "do my duty" in regards to eating all that fruit.

With regrets, the time came for me to depart. I had lots of places to visit and operate from before heading back to South Carolina . . . and Peggy. W4BPD

Down Under Award

This large colored attractive certificate will be awarded to any license ham who has QSL confirmation of having worked the following VK areas:

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Mark Losseff — Ex U2GU and active SWL

We have been informed of the passing of Mark Losseff of Kaluga, U.S.S.R. Mark was an amateur before the war and was licensed as U2GU. He was the first Russian amateur to work the U.S. on 7 MHz in August 1927. This was done with 5-watts power, and a two-tube receiver. He was also a commercial operator aboard merchant ships and ice breakers. He was a political prisoner during the time of Stalin, and had been an active SWL since the war.

WTW Report

After a visit with Wayne and Jim when Peggy and I were on our way to Expo 67, some of the rules of WTW are being changed. The basic rules are unchanged. Starting from this time on we are going to accept cards in multiples of less than 100. We are starting a WTW Honor Roll which will be in each issue of 73 Magazine. The interest at this time is growing by leaps and bounds and we think by having a monthly Honor Roll the interest will grow even more. Here are the new rules about submitting your cards:

28-MHz CW or Phone: After WTW-100 you may submit cards in multiples of 10 or more up to 150; any number over 150.

21-MHz CW or Phone: After WTW-100 you may submit cards in multiples of 25 or more up to 200; any number over 200.

14-MHz CW or Phone: After WTW-100 you may submit cards in multiples of 25 or more up to 200; any number over 200.

7-MHz CW or Phone: After WTW-100 you may submit cards in multiples of 10 or more up to 150; any number over 150.

3.5-MHz CW or Phone: After WTW-100 you may submit cards in multiples of 10 or more up to 150; any number over 150.

160-Meter CW or Phone: You may submit cards in multiples of 25 or more up to 50; any number over 50.

Submit your cards along with your tally sheet to your usual QSL check point as listed in 73 Magazine. If you don't have this information, drop me a line with an SASE (self-addressed stamped envelope) at the address shown above. The address of your check point will be sent to you. Don't send any cards to me unless you are sure there is no

check point for your area. There are presently check points for most areas of the world and the U.S.A. (See list in last month's issue of 73.)

I want to caution everyone again about the possibility of sending in cards that are not authentic. Cards are inspected very carefully for such things as call-sign changes, date changes, signature changes and comparisons, and general card appearance—one that doesn't look like any card that has been submitted before. Remember fellows, I look at lots of cards and I know how most of them look. I also see many reports of stations that the DX'ers have been working—especially the rare ones. If you are the only one in the world that has worked some rare spot and you get a card for the QSO, I am going to write the sender of the card and ask questions. Fraudalent cards may disqualify you from WTW-we intend to make this an honorable award and we are going to keep it that way. I have been around a long time and I know something about DX; I also know something about photography and the printing business. But mainly I know what DX and other fellows have been working and I know what stations don't QSL as a rule.

Please police your own cards OM and let's both of us keep from embarrassing each other. I hate to have to say such things, but it's necessary because at times I have to do some of the things mentioned above. If your cards are good honest ones you have nothing to worry about. So much for the QSL card situation—I hope I have not made anyone mad by the above comments and remarks.

Everyone who has received our WTW Country/Tally sheets, please, in the blank spaces I allowed enter the obvious countries I missed. One of these days I will be making up new lists on a greatly reduced scale.

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When they are ready for distribution I will let you know. Space will be allowed on them for about 10 years of record keeping and this time there will be no missing countries like the first run has. Another item I would like to mention is about QSL cards you send me or to the verification points. Please understand how we operate—we send \$1.00 along with each application to 73 Magazine. This helps defray the cost for the certificate, mailing and handling. Now the problem of returning your cards. Whether you want them returned by registered mail, or certified mail (cheaper than registered), first class, or third class is up to you. We will return your cards via the class of mail that you cover in your allowance for this. This is above and beyond the \$1.00 for the certificate. Please don't send any cards directly to 73 Magazine-this upsets our system and slows everything down.

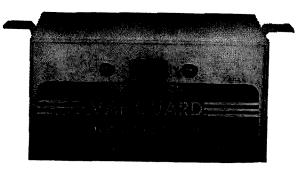
I would like to say again that the WTW DX award is not in competition with any other DX award. It's a new DX award and will stand on its own feet. It's designed with the weary DXer in mind, something new for him to shoot for. If you are too old, and not interested in working the DX that's in there, it's not for you. There is always 75-meter phone, 10-meter short skip, traffic handling, etc., for those of you who are not DX'ers any longer.

Miller WTW Credits

The seemingly conclusive and massive evidence than Don Miller actually never visited the Laccadive Islands and actually operated from some other place when he signed VU2WNV/4 caused a good deal of distress for the WTW award committee, as you can appreciate. Obviously this meant that the serious questions that had been raised about other Miller expeditions should be considered with less weight being given to Don's "word" and more to the statements of others and the circumstantial evidence.

The award committee rapidly found itself getting into the same hassles as the ARRL committee, which is an extremely unenviable position. Happily, a solution suggested itself which seems simple in retrospect. Since WTW accepts any country for the award that is accepted by any national amateur radio society, it was a simple matter to carry this one step further and accept any DXpedition or unusual operation that is accepted by

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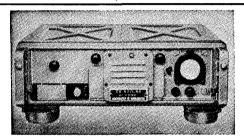
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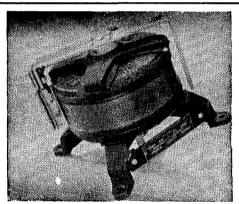


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any national amateur radio society.

This is bad news for the DX'ers, unfortunately, for this means that the Don Miller operations at St. Peter and Paul Rocks, Heard Island, Chagos, Laccadive Islands, and Navassa Island cannot count for WTW, since not one national society accepts any of these operations as valid. And it seems highly probable at this writing that the ARRL DXCC Award Committee may at any time rescind its credit for the Baha Nuevo, Niue Island, Blenheim Reef, Minerva Reef, and one or two others, many of which will affect the WTW credits if deleted.

We would have infinitely preferred it if we could have accepted as many operations as possible for WTW, but the prospect of trying to get positive proof of where Don has or has not really been is exhausting for he seems to have little or no evidence to offer in support of his claims for his operations.

Worked The World Rules

The WTW award is issued by 73 Magazine and is available to radio amateurs who can provide proof of contact with amateur radio stations in 100, 200, 300, and 350 countries on one particular band using one mode. All contacts must be made within a five year period, with no cards dated before May 1966, the start of the award.

Now, to define our terms. A country is any place in the world which is accepted by any national amateur radio society as a "country."

Proof of contact is normally a QSL card which clearly shows the band used, the mode used, the call of the station contacted, the time and date of the contact, the signal report, and the location of the station sending the card.

Separate awards are available for phone and CW and for each amateur band.

Cards may be sent to Gus Browning W4BPD, Route 1, Box 161A, Cordova, South Carolina 29039 together with \$1 or seven IRC's to help defray administration expenses or to any other societies or clubs listed in the WTW columns in 73. It is a good idea to send your cards registered and include first class postage for their return.

The WTW award is for your enjoyment and it is hoped that no one will attach more importance to it than it really deserves. Certainly, cheating is unforgivable.

. . . W4BPD

Worked the World

14 MHz SSB WTW-200

- 1. Gay Milius W4NJF
- 2. "Hop" Hopple W3DJZ
- 3. Dick Leavitt K3YGJ
- 4. Joe Butler K6CAZ

14 MHz SSB WTW-100

- 1. Gay Milius W4NJF
- 2. Bob Wagner W5KUC
- 3. "Hop" Hopple W3DJZ
- 4. Bob Gilson W4CCB
- 5. Jim Lawson WA2SFP
- 6. Joe Butler K6CAZ
- 7. Warren Johnson WØNGF
- 8. Lew Papp W3MAC
- 9. George Banta K1SHN
- 10. Dan Redman K8IKB
- 11. Paul Friebertshauser W6YMV
- 12. Jav Chesler W1SEB
- 13. James Edwards W5LOB
- 14. Bill Galloway W4TRG
- 15. Olgierd Weiss WB2NYM
- 16. Jose Toro KP4RK
- 17. Gerald Cunningham W1MMV
- 18. Edward Bauer WA9KOS
- 19. Dick Tesar WA4WIP
- 20. G. "Gus" Brewer W4FPW
- Iack McNutt K9OTB
- 22. Charles R. Sledge W4JVU
- 23. Ira C. Crowder DL5HH
- 24. James Leonard W4FPS
- 25. Richard Leavitt K3YGI
- 26. Gordon Read VE6AKP

- 27. Paul Haczela K2BQO
- 28. Don B. Search W3AZD
- 29. Len Malone WA5DAI
- 30. Egon Gadeberg OZ3SK
- 31. G. Coull ZL3OY
- 32. John F. Berryman K4RZK

14 MHz CW WTW-100

- 1. Vic Ulrich WA2DIG
- 2. James Resler W8EVZ
- 3. Dan Redman K8IKB
- 4. Robert C. Sommer W4CRW
- 5. John Scanlon WB6SHL
- 6. Newton K. Gephart W9HFB
- 7. Fred A. Fisher W5ODI

21 MHz SSB WTW-100

- 1. Ted Marks WA2FQC
- 2. James Lawson WA2SFP
- 3. Joe Hiller W4OPM
- 4. Scott C. Millick K9PPX
- 5. Paul Friebertshauser W6YMV

21 MHz CW WTW-100

1. Joe Hiller W4OPM

28 MHz SSB WTW-100

- 1. James L. Lawson WA2SFP
- 2. Ansel E. Gridley W4GJO

7 MHz CW WTW-100

- 1. Rex G. Trobridge W4BYB
- 2. R. Sigismonti W3WID

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FOR CLOSED CIRCUIT OR AMATEUR TV

THE VANGUARD 501 Is a completely automatic closed circuit television camera capable of transmitting sharp, clear, live pictures to one or more TV sets of your choice via a low-cost antenna cable (RG-59U) up to a distance of 1000 ft without the need for accessories or modifications on the TV sets. The range can be extended indefinitely by using line amplifiers at repeated intervals or by using radio transmitters where regulations permit.

There are hundreds of practical uses In business, home, school, etc. for any purpose that requires you or anyone chosen to observe anything taking place anywhere the camera is placed. Designed for continuous unattended operation, the all-transistor circuitry of the 501 consumes only 7 watts of power.

SPECIFICATIONS:

- Measures 23/4" x 4" x 7" (excluding lens and connectors).
- Weighs 31/2 lbs.
- Operates on 100-130 volts 50 or 60 cycles, 7 watts.
- Tested at 10° to 125° F.
- Advanced circuitry utilizing 35 semi-conductors most of which are silicon.
- Field effect input circuit for minimum video noise.
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- RF output 30,000 microvolts adjustable for channels 2 to 6.
- Video output 1.5V p-p composite with standard negative sync (random interlace).
- Viewable pictures obtainable with illumination as low as 1 ft. candle.
- Vidicon controlled light compensation; 150/1.
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- New long life, sub-miniature vidicon with spectral response similar to Type 7735A.
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Pre-set adjustable controls include the following: Video gain, video compensation, pedestal level, target voltage, beam voltage, beam alignment, electrical focus, horizontal frequency, horizontal size, vertical frequency, vertical size, vertical linearity, modulation and RF frequency output.

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Lafayette HA-600



The Lafayette HA-600 is an all transistorized, general coverage, receiver which incorporates both 117 Vac and 12 Vdc power supplies. Covering five amateur bands, this new receiver uses 2 FET's in the front end rf stages to assure high sensitivity with a low noise factor. Ten high-performance transistors and 8 diodes compliment the FET's to provide a new high in receiver engineering. Tuned rf and mixer stages combine with two mechanical filters to provide high sensitivity with superior selectivity for AM/CW/SSB reception.

Other fine features include a variable BFO, series-gate noise limiter, avc, electrical bandspread, 100 kHz crystal calibrator product detector for SSB/CW, and accessory 117 V socket. Selectivity ±6 kHz at 60 dB down, ±2 kHz at 6 dB down. Intermedite frequency: 455 kHz. BFO frequency: 455 kHz ±2.5 kHz. Antenna impedance: 4, 8, and 500 ohms. Headphone impedance: 8 ohms. For further information about the HA-600 write Lafayette Radio Electronics Corporation, 111 Jericho Turnpike, Syosset, L. I., New York 11791.

Barker & Williamson LPA-2000

Barker and Williamson has announced production of a new rf power amplifier capable of delivering the maximum legal power of 1 dc kolowatt input for the amateur service. Designated the LPA-200, this amplifier will deliver better than 1400 watts PEP out-

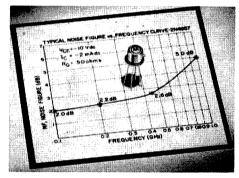
put to the antenna at the 2 kW input level on SSB. The power supply utilizes silicon diodes to maintain low heat and maximum efficiency. The operator can select either 3000 volts for SSB, or 2100 volts for CW, RTTY, and tune up. Two meters on the face of the amplifier monitor all circuits. Relative output sensitivity can be adjusted from the front panel.

The B & W LPA-2000 Linear Amplifier is designed for a frequency coverage of 80 through 10 meters with overlap for MARS. It employs a 3-1000Z Eimac zero-bias triode with a rating of 1000 watts plate dissipation. This desk-top unit has a built-in power supply and uses forced air blowing for cooling. It stands approximately 18 inches wide, 16% inches deep, and 11 inches high; weight is approximately 75 pounds.

Complete technical details are available on request from Baker & Williamson, Bristol,

Pennsylvania.

Motorola Silicon Transistors



A new series of silicon transistors for highgain, low-noise amplifiers and mixers or other VHF/UHF small signal applications to 1 gHz is now available from Motorola Semiconductor Products Inc. The 2N4957-9 series of transistors features maximum noise figures as low as 3 dB and minimum power gains as high as 17 dB at 450 MHz in the common emitter configuration. At 1 gHz the 2N4957 delivers a typical common emitter power gain of 13 dB at a typical noise figure of 5 dB. This performance makes them well suited for critical front-end applications with a relatively low price in comparison with other transistors designed for operation at these high frequencies.

Further information and complete specifications are available from the Technical Information Center, Motorola Semiconductor Products, Inc., Box 955, Phoenix, Arizona 85001.

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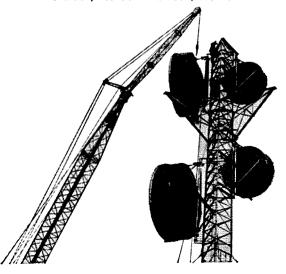
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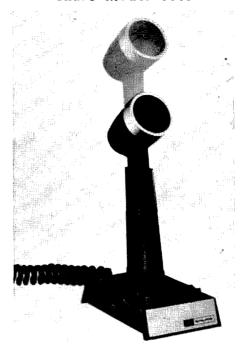
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Shure Model 444T



This new variable output, transistorized base station microphone, specifically designed for radio communications applications, provides optimum performance when used with single sideband transmitters as well as AM and FM units. It is particularly useful with transmitters which lack sufficient gain to attain 100% modulation.

The Model 444T gets its variable output advantages from a built-in, two transistor preamplifier with volume control. The preamplifier unit is equipped with a self-contained battery with a life of over 300 hours. In design and appearance, this new microphone is similar to the Shure Model 444. It has an extremely rugged controlled-magnetic element, and provides tailored frequency response for highest "talk power" as well as protection from clipping or overload. The frequency response is 200 to 6,000 Hz. Other features include press to talk bar, adjustable height (9½-12 inches), and a rugged Armo-Dur case. For additional information write Shure Brothers, Inc., 222 Hartrey Avenue, Evanston, Illinois 60204.

Amperex Power Transistors

A series of silicon n-p-n Power Transistors, A200/A201/A202, which feature high-power output and high-power gain with excellent fail-safe characteristics, has been announced by Amperex Electronics Corporation. They are low-voltage devices, intended for use in

Antenna Handbook, Volume 1

Ken Glanzer's new Antenna Handbook, Volume I published by Cowan presents some very good information, but be careful of errors, K7GCO's style of writing is charming and except for a few drafting errors, the illustrations are bountiful and clear. However, I found several places where I could argue for accuracy or generalization of specifics.

The author, for example, in referring to rf ammeters in balanced feeders between his tuner and antenna, says, "The rf ammeters will show unbalance in the feedline, indicate modulation percentage, relative impedance, and adequate grid drive." First of all, what unbalance in the feed system-the tuner, the antenna, the feedlines, or all three? Also, correct modulation percentage will be indicated only if a pure sine wave is used and carrier shift can nullify that; voice modulation cannot be accurately determined. Furthermore, the rf ammeters will indicate relative impedance only in the absence of reactance or its common power-factor problem. And lastly, the rf ammeters in the feedline will indicate adequate grid drive only in very carefully controlled laboratory demonstrations which are of little practical value to the ham. For the newcomer, this is too much generalization of fact if he seriously wants to learn the amateur game. The author has rolled over other minor sins almost as rapidly.

I regret very much that I can not recommend the first edition of this handbook to anyone who is unable to readily sort out opinion and typographical errors from what he needs to build his knowledge upon.

. . . George Bonadio W2WLR

Conductive Silver Epoxy

The Starnetics Company has just brought out a new aerosol-packaged conductive-silver coating called CS-1. This material results in surface sheet-resistivities of less than 0.1 ohm per square. It is air drying, and has applications in shielding, grounding, terminations and repair operation. Pure silver is dispensed within a plastic binder, resulting in a dense, thick, adherent film with a conductivity approaching that of silver. Trial six-ounce containers are available at \$14.50 each. For further information, write Starnetics, 10639 Riverside Drive, North Hollywood, California 91602.

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Transistors for Audio Frequency

Transistors are being incorporated into more and more amateur equipment today, and many hams are interested in their applications at high frequencies. However, before you can use them at HF and VHF, you have to know something about their characteristics and behavior at the lower audio frequencies. G. Fontaine, the author, provides a very detailed study of the principles of the audio frequency applications of the transistor, not by providing a series of amplifier circuits, but by a thorough explanation of the significance of the various parameters and the ways in which they can be used in the design of an audio-frequency stage.

The text is excellently illustrated, in many cases with three colors, and the mathematical calculations are kept simple and direct. The first chapter covers concentration curves, a relatively new means of explaining both static and dynamic effects of transistors, and stresses their importance. These curves can be used to explain characteristics, and to give a qualitative explanation of the capacitive effect found in semiconductors. The importance of these effects becomes quite clear when you start to use solid-state devices in radio frequency and switching applications.

The chapters in the second part cover small signals, transistor configurations, choice of coupling systems, stabilizing and biasing circuits, transistor noise, large signal response, symmetrical audio frequency stages, negative feedback, thermal behavior and cooling problems and practical circuit design. Whether you are a newcomer to solid state or a seasoned oldtimer, this book will be a welcome addition to your bookshelf.

Lafayette 1968 Catalog

Lafayette Radio Electronics Corporation announces its new 1968 512-page catalog, No. 680, with the latest in electronics and stereo high-fidelity, now available free upon request. This new catalog features all major manufacturers, plus Lafayette's own toprated components. Several new pieces of equipment feature new integrated circuits. A complete selection of stereo hi-fi, citizensband 2-way radio, tape recorders, ham gear, test equipment, radios, TV's and accessories. cameras, optics, marine equipment, auto accessories, tools, books, etc. The free Lafayette 1968 catalog No. 680 may be obtained by writing to Lafayette Radio Electronics Corp., P.O. Box 10, Dept. PR, Soysset, L. I., New York 11791.

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AN ADDITIONAL INCENTIVE FOR NOVICE HAMS

Because I wish to improve the overall strength of amateur radio by encouraging greater numbers of active hams, I have therefore decided on a new incentive for beginners to our hobby.

As a parent, I understand the need for a youngster to "find himself"; to shift rapidly from one interest to another. As a dealer in radio equipment, I sympathize with folks who question the depth of their son's new interest. Is he really going to stick to this "hamming?" This question is in the mind of most dads who accompany their sons to our "ham

The advent of our long-awaited FCC incentive licensing program, calculated to upgrade our electronic knowledge and our operating skills, will no doubt cause many existing hams with borderline sincerity to leave our fold, rather than submit to a program of self-improvement. In the long term, however, our over-all strength should be greater, for the good of our country, and our numbers must surely increase, particularly as the government forces the improvement of the CB licensing

The plan outlined below is designed to help increase the number of novice licensed hams. It is hoped that these novice hams will be encouraged to upgrade their licenses to that of general; and that those who fear the expenditure of a beginner's outfit as a waste will be encouraged to proceed in our hobby, knowing that they have already paid for much of their general class equipment.

1. Effective with publication of this notice, the Herbert W. Gordon Company of Harvard, Massachusetts, will in effect provide you with your

novice station at no charge to you.

2. To obtain your novice station this way it will be necessary for you to select any gear of your choice by either personally visiting our show rooms, or by screening our mail order listings. At the time of your purchase, your sales slip will be validated by me personally, with a special rubber stamp and my signature. You will, of course, pay for your gear in the conventional way. Title will be yours upon completion of all agreed upon terms.

3. Within a period of up to one year from the purchase date, and provided that no physical impairment has been made to your equipment, this company will allow you full recovery of your original purchase price, towards the cost of any gear subsequently selected to further your ham ambitions. The gimmick, of course, is that you must have advanced your license position within the year's time, or else no credit will be allowed. Proof of advancement can either be a photostat of your new license, or a change in the Callbook listing.

4. Your original purchase is guaranteed in accordance with our standard policy—6 months on used equipment, 12 months on new gear. Tubes, diodes, transisters, and fuses are ex-

5. Transportation costs must be borne by you. 6. Instruction books and all originally supplied accessories must be returned with the associated

7. This special offer will expire May 1, 1969, unless, at the discretion of this company, it shall be extended and suitable public notice given in our advertisements.

8. The term, "novice station," shall be interpreted to mean a receiver and a transmitter, or a transceiver, intended in part to fulfill the re-quirements of legal operation in our novice

Study these terms and see if they don't advance your cause. The net effect, if you are a beginner and can succeed in getting a general license within a year, is that your first outfit costs you nothing and that its full value will be credited to your improved, more powerful sta-

Of course we benefit too. Our very large and diversified stock of used equipment should satisfy everyone. Many of those buying will doubtless be happy with their purchase for longer than a year. But, despite the fact that even with salt and pepper added I can't eat this gear, I'll still be smiling when you bring your pieces back to us and flash your new general license.

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Propagation Chart

NOVEMBER 1967

ISSUED SEPTEMBER 6

J. H. Nelson

EASTERN UNITED STATES TO:

GMT	: 00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7A	7	7	7	7	7B	14	21	21A	21
ARGENTINA	14	14	14	14	7	7	14A	21A	28	28	28	21
AUSTRALIA	21	14	7B	7B	7B	7B	7B	14A	144	14	21	Ź1A
CANAL ZONE	14	14	7	7	7	7	14	21	28	28	28	21
ENGLAND	7	7	7	7	7	7A	21	28	28	21	14	7.4
HAWAII	21	14	7A.	7	7	7	7	7B	14A	21A	28	28
INDIA	7	7	7B	7B	7B	7B	14A	21	14	14	14	14
JAPAN	14	14	7B	7B	7	7	7	7	7B	7B	14	21
MEXICO	14	7	7	7	7	7	7A	14A	21	21	21	21
PHILIPPINES	14	14	7B	7B	7B	7B	7B	14B	14 B	14B	7B	14
PUERTO RICO	7A.	7	7	7	7	7	14	21A	21A	21A	21	14
SOUTH AFRICA	14	14	14	14	7B	14	21A	28	28	28	21	14
U, S. S. R.	7	7	7	7	7	7B	14	21A	14	14	7B	7
WEST COAST	21	14	7	7	7	7	7	14A	21 A	28	28	2 IA

CENTRAL UNITED STATES TO:

ALASKA	21	14	14	7	7	7	7	7	14	21	2 1A	21A
ARGENTINA	14A	14	14	14	7	7	14	21A	28	28	28	21
AUSTRALIA	21A	14	14	7B	7B	7B	7B	14	14A	14	21_	21
CANAL ZONE	14	14	14	7	7	7	14	21	28	28	28	21
ENGLAND	7	7	7	7	7	7	14	21A	21A	21	14	7A
HAWAII	21	14	14	7	7	7	7	7	14A	21A	28	28
INDIA	14	14	7B	7B	7B	7B	7B	14A	14	14	14	14
JAPAN	21	14	713	7B	7	7	7	7	7B	7B	14	21
MEXICO	14	7	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	14	7B	7B	7B	7B	7B	7	14	14	7B	14_
PUERTO RICO	14	14	7A	7	7B	7	7	21A	21A	21A	2 1A	21
SOUTH AFRICA	14	14	7A	7B	7B	7B	21	21A	28	28	21A	21
U. S. S. R.	7	7	7	7	7	7B	14	21	14	14	7B	7B

WESTERN UNITED STATES TO:

ALASKA	21	21	7A	7	7	7	7	7				
ALASKA	121	21	IA	<u> </u>	+-	+-	1-	1	14	21	21A	21A
ARGENTINA	21	14	14	14	7A	7	7B	14A	21A	28	28	28
AUSTRALIA	28	28	21	14	14	14	7	7	14A	14	21	21
CANAL ZONE	21	14	14	7	7	7	7	14A	28	28	28	28
ENGLAND	7B	7	7	7	7	7	7B	14	21A	21	14	7B
HAWAII	28	21	14	14	14	7A	7A	7	144	21A	28	28
INDIA	14	14A	14	7B	7B	7B	7B	7	14	14	14_	14
JAPAN	28	21	14	78	7	7	7	7	7	7B	7B	21A
MEXICO	14	7A	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	28	21	14	14	7B	7B	7	7	14	14	7B	HA
PUERTO RICO	14	14	7	7	7	7	7A	14A	21A	28	28	21
SOUTH AFRICA	21	14	7	7B	7B	7B	7B	14A	21 A	28	28	21
U. S. S. R.	7B	7	7	7	7	7_	7B	7B	14	7B	7B	7B
EAST COAST	21	14	7	7	7	7	7	14A	21A	28	28	21A

- A. Next higher frequency may be useful this hour.
- B. Very difficult circuit this hour.

Good: 2-5, 7-14, 20-25, 27-29

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VHP: 3-4, 13-14, 22-25, 28

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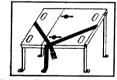
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(Continued from page 4)

But, let us see what the Department of Communications of the Government of India has to sav about all this. ". . . the letter of January 3, 1967, which was claimed by Dr. Miller to have been issued by this Department to him and the authorization contained in it, has not been issued under the authority of the Government of India. So far as this document is concerned, it appears to be a clear forgery. Amateur licenses/permits are never issued by us in this form and the letterhead of the forged document is an old one which was in use in 1963 and before, and the officer under whose signature these licenses are issued is not Mr. V. M. Gogte, but another officer. Dr. Miller had with him a 1963 communication, addressed to him by Mr. V. M. Gogte that it would not be possible for the Government to issue him an amateur license to operate from Sikkim, Bhutan and Andaman Nicobar Islands, etc."

The Department of Communications, in another letter, says, ". . . the telegram to Dr. Miller asking him to contact Brig. Patel to collect his license for amateur operation from Bombay is an authentic one. But the telegram which has been claimed by Dr. Miller to had been received from the Indian Consul in East Africa . . . is obviously false and ficticious. The copy of the telegram does not at all indicate that it was sent by the Indian Consul in East Africa. In any case, there is no such person in East Africa . . . Neither the office in Mombasa nor the Indian Mission in Nairobi authorized any Dr. Miller at any time to operate any radio station from the Laccadives.'

The same letter goes on to say, "It has been confirmed by the authorities in India that Dr. Miller never landed in any of the islands in Laccadives during the period."

Well, friends, would you say that there is a reasonable doubt left as to whether Don was either licensed or actually visited the Laccadives? If Don did not visit the Laccadives then most certainly a lot of hams have been hoaxed.

Isolated Incident or Pattern?

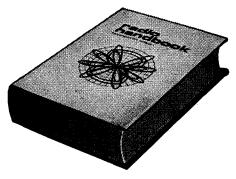
Let's dig back a bit into the past and see what we find. A letter from Iris Colvin just received from Sierra Leone and prompted by my September editorial says, "The only really authoritative statement that I can make about Don (or Chuck), is that Chuck was

not on Ebon Atoll. The first that we heard about the problem of Chuck's operation from Ebon, was information from Jimmy Gima KG6SB, who is with Communications for the Trust Territories of the Pacific, in Saipan. He stated that he had had many complaints from hams saying that beaming directions would indicate that many of the Don Miller operations in the Pacific could not be from the stated localities.. It was believed that Chuck was actually on one of the Caroline Islands and, from the viewpoint of the Trust Territorial Government, operation in either the Carolines or Ebon was illegal, because no permission had been granted by the Trust Territories. Jimmy requested, officially, that we investigate, first-hand, as to whether Chuck had been on Ebon. Chuck's arrival and operation on Ebon would be almost like saying that someone had been visiting you in your apartment for several days, but you just didn't happen to see him or any evidence of his having been there. An operation on a remote island, where strangers are feared, and ships are a rare treat, where the area is constantly watched by the natives gathering food and the inevitable fishing boats, which must supply fish daily, where there is no electricity or lights at night, where any indication of unusual sounds or light would be noticed, is an impossibility which stretches the limits of the imagination. There was no grain of evidence to support the fact of his presence . . . no tin can . . . no cleared area . . . and not even a rumor of suspicion among the natives. There are other indications that Chuck was not on Ebon and that Don is even more involved than Chuck.'

"We heard Chuck operating from Ebon and on several occasions gave him a call. Each time he immediately went off the air. After Chuck had rejoined Don we contacted him and asked for more information. Each time Don would take the mike and say that no matter what we thought or what Ebon we were on, Chuck had been on Ebon. It was Don who described the island, the one with the long wooden wharf. The description sounded good, except that there is no wharf on Ebon Atoll. Don is such a good salesman that I began to wonder myself if perhaps there were not another Ebon, one actually owned by Ecuador, but the latitude and longitude of his Ebon was the same as the Ebon on which we were then located.'

"Don has many tricky tactics. He immediately accused us, saying that it was only our

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word against his. We sent a statement signed by the Officials of Ebon to the ARRL. A carbon of this document is enclosed. Someone should get to the bottom of Don Miller's questionable operations. Many hams have taken beam bearings and sent the information to ARRL, but no one has disclosed the full story to the world. If the accusations are true we should not wait for the State Department or foreign governments to take action. The hams should be allowed to decide what they expect of a good radio operation and then insist that these standards be upheld. No ham can exist without support of other hams and their OSO's."

"Everywhere we have been, the hams have been our greatest help in obtaining licenses. Previous DXpeditions or temporary amateur radio operation has served to open the doors for additional operations . . . at least to the extent that the previous amateur has helped to establish precedent and procedures for licensing. Illegal operations increase the distrust and misunderstanding of anything connected with amateur radio. When written approval cannot be obtained, verbal approval of the operation is the next best thing, especially if the amateur is friendly, helpful, causes no trouble, and creates interest in a new and fascinating hobby. A single few days operation should not be considered the end and completion of a project. If it hinders future amateur radio operation, it has failed, even though it may have temporarily succeeded as having counted as a one-time new country.'

"The amateur fraternity has always been capable of monitoring it's own frequencies and have maintained a strictly non-commercial and non-political communication. This has developed into an international confidence between individual hams. This image of the amateur and this confidence that our bands will not be used illegally must be maintained. This is a job for the amateurs themselves.'

There is little that I can add to Iris' letter. She certainly has made a point that every one of us should think about.

When the first rumors of irregularity reached me about the Ebon operation I asked Chuck on the air about it and got no answer. Then I called Don and asked him. He said that Chuck was positively on Ebon Atoll. I asked how come, if he was there, the natives had not seen him. Don said that Chuck had come in at night from the ocean

side of the island and landed and had not gone into the lagoon where he might have been seen. Since the entire rim of Ebon is ringed by a partially submerged reef about 100 feet offshore this explanation was not credible. I've been on enough atolls to know you aren't going to land from anywhere but the lagoon and I've skin dived around enough coral reefs to know that you aren't going to fool around with them.

While Chuck's subsequent demise makes speculation about Ebon rather academic, it certainly is an interesting study as a Don Miller managed expedition.

As the evidence mounts up against Don, all hamdom is waiting for him to produce a documented report on his past travels that will once and for all prove that he did actually operate from the countries he says he did. Iris suggests this . . . I have asked for this . . . and perhaps all of you can get after Don when you work him and insist that he stop beating around the bush on this long overdue report. Don is a very sincere and convincing person when you meet him, and I know that all of us who had considered ourselves his friends are extremely upset that he has not come up with satisfactory answers.

Let's start with Laccadives. Here we have the Government of India flatly saying that Don positively was not there . . . did not operate from there. When you contact Don request him to provide an official document, such as a passport, showing that he was in the Laccadives during the VU2WNV/4 operation. I think you will get anger and abuse, but no proof. I would like to see a copy of the documents, and I know ARRL would. How about you?

Amateur Responsibility

"The amateur fraternity has always been capable of monitoring its own frequencies, and has maintained a strictly non-commercial and non-political communication. This has developed into an international confidence between individual hams. This image of the amateur and this confidence that our frequencies will not be used illegally must be maintained. It is a job for the amateurs themselves," writes Iris Colvin from 9L1KG in Sierra Leone. It is certainly about time that we got to the bottom of Don Miller's operations. There is no reason why we should wait for the State Department, the FCC, or foreign governments to take action. This is,

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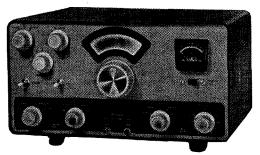
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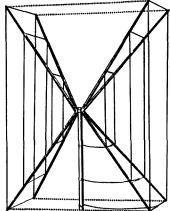
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basically, our problem.

A letter has just come in from the Indian Brigadier General who helped Don get his Indian license saying that, "... Don Miller never landed on the Laccadives Islands and, therefore, could not have operated from these islands. As a result of my intervention with the authorities he was issued a call sign VU2WNV. This was given to him for Bombay only and it was made amply clear to him that this license was NOT valid for operation from the Laccadives Islands."

Yet I have here a QSL card confirming a contact with VU2WNV/4, Laccadives Island, Don Miller W9WNV operator. This gives me the choice of believing either the Indian Brigadier General who, incidentally, is a good personal friend of mine, and whom I have every reason to trust, or Don Miller, who has so far refused to present any evidence proving that he was there, or, for that matter, that he was actually at any of the many other spots where serious questions have arisen about his true whereabouts. A letter to Don about this brought evasive answers. A letter to his attorney brought no answer.

It seems to me that every amateur who donated money to finance this series of DXpeditions has a right to know whether he has been the victim of one of the biggest hoaxes in the history of ham radio or not. I think all of us want some clear proof that Don actually was in the Laccadives when he said he was operating from there. Was Don, as the circumstantial evidence seems to indicate, almost 1500 miles from the Laccadives?

When it comes down to it, this is not my responsibility, it is not the responsibility of the ARRL . . . it is *your* responsibility. The amateurs who found beam headings off should raise cain. Every time a serious suspicion was raised, there should have been an outcry that could be heard around the world. And the very most of all, we should have been reading about this in the ham magazines long before this. Come on fellows, these are your frequencies, protect them.

The New Rules

Most of the fellows I've talked with on the air seem to have accepted the new regulations calmly. A few of the Generals were rather put out at the prospect of having big lumps of their phone bands taken away.

My first reaction is one of disappointment. I am disappointed with the ARRL for bring-

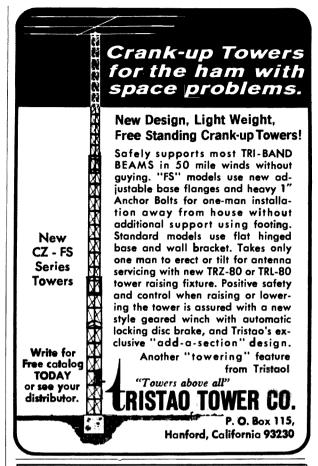
ing this whole matter down on our heads and I'm disappointed with the FCC for getting conned into doing the ARRL bidding. I'm further disappointed that after all this effort the FCC passed up opportunity to move amateur radio ahead by updating band allocations and instead has, for the most part, just put us back where we were twenty years ago.

With the bottom 50 mHz of 80-40-20-15 allocated to Extra Class only, the fellow who is going after DX in the future will have to have an Extra Class license or else he just isn't going to have a ghost of a chance on CW.

Now it most certainly is true that most of us can get that Extra Class license if we really want it. The fellow who is interested in CW will automatically get his code speed up over the 20 wpm requirement, so that is no real obstacle. The phone man merely has to sit down and practice code for a few months, like it or not. Of course, as the armed forces found when they taught code, there are about 25% of us who just will never be able to do much with code, no matter how hard we try or how long we work at it. Too bad about them. Tough luck.

Assuming that you do have a natural sense of rhythm and that you swing with the code, there is still that matter of the theory exam. I ran a poll a few months ago and found that % of the Extra Class readers of 73 are working in electronics. By the way. over 90% of the Extra Classers read 73, whatever that means. I've talked with a few nonengineers on the air that have managed to get their Extra. They reported that it took a massive effort on their part to make the grade, but that they felt a great sense of accomplishment when they made it. Very few have gone this route so far. The great bulk of the Extra Class licensees are long time CW ops who are engineers and had merely to report for the exam to pass it.

The DXer either has to specialize in 40 or 20 meter phone DX'ing or else get that Extra ticket. Even 80 and 15 meter phone DX'ing will be out for him. This isn't too serious for there are only about 10,000 ops who are interested in DX chasing anyway, so only a small percentage will be affected. The great bulk of the active amateurs will be able to continue their rag chewing, RTTY, traffic handling, emergency nets, VHF, and the like unperturbed. Perhaps we could start a Help The Needy Plan for DX stations



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to occasionally come on up to the General Bands and be kind to the handicapped.

Reciprocal Licensing

Agreements with foreign countries are coming along, but very slowly. It seems to take years for simple paperwork to pass through Foggy Bottom. A letter from a U.S. ham in Spain gives us a good idea of what some of the problems are that other countries have to face when dealing with State. "I can tell you what is holding up reciprocal licensing between the U.S.A. and Spain. A guy named Black in our own State Department in Washington who continues to insist that the U.S. hams must have privileges in Spain that just are not available to the Spanish themselves! I persuaded the Embassy to go in with recommendations that a treaty be signed allowing reciprocal operating privileges under the existing regulations of both countries—no soap with Black, so the better than 90 hams here who can meet the Spanish requirements are left in the cold and without U.S. support." He goes on to say, "We need heavy support from the hams in the U.S., and I do not mean the ARRL. as they seem to care less. All I get from them is platitudes."

Another U.S. ham, recently returned from Yugoslavia and Hungary, reports that they are, for the present, issuing licenses unilaterally to visiting hams. Since the number of YU and HA hams visiting the States is about zero I can see why they might not worry about reciprocal licensing. When I visited those countries a couple of years ago they were on the verge of this move, so it doesn't surprise me. Our little Vietnam do seemed to be holding things up as much as anything, at the time.

Back issues

Each month we have tried to print a few thousand extra copies of 73 so that we would have them available as back issues. Recently, with the 84th issue of 73 coming out, even our large storage facilities were beginning to feel the strain. We checked with the post office to see if old magazines might be mailed as books since the advertising was well out of date. Getting an OK on this, we published the ad for the back issues at \$1 per year, figuring that it would cost us about 25¢ per bundle to gather them together, wrap them, address them and mail them. The postage should have been about 20¢ per year, plus perhaps another 5¢ for

record keeping, and leaving 50¢ profit each. Alas, after the first few hundred bundles someone got eager at the post office and word came back that the postage would have to be for parcel post or the transient magazine price, which came out to close to \$1 per yearly bundle. Too late to do anything about it now . . . the ad had not only run in the August issue, but was set for September and it was too late to stop it. We appealed all the way to Washington . . . no, advertising is never too old to be anything but advertising and we would have to pay the full postage charges.

Adding up the disaster, and neglecting the original cost of the magazines of about \$3.00 per year just for the printing, we managed to take an interesting net loss on the project. If any of you readers find you are really enjoying the back issues we have sent to you we will not reject any conscience donations. We might even pull one or two of the pins

out of your voodoo doll.

Say, while you're sending money, why not include an extra \$3 each for binders to hold all those magazines? This keeps friends from barrowing them as well as making them look FB on the shelf. Our binders are stamped with the year so don't forget to tell us what years you have. ...W2NSD

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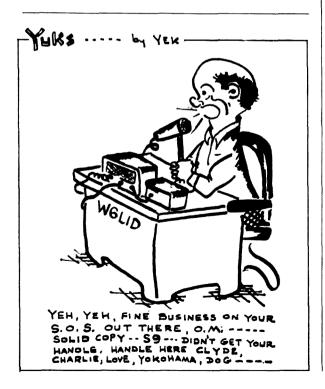
(Continued from page 2)

strictions, the same will apply to the General who passes the Extra exam, and operates in the restricted parts of the band.

Although Wayne is covering the DXplosion pretty much, I would like to report that we have strong evidence that Don was legitimate on Niue Island. I gather that the natives were a bit restless and that they wouldn't welcome him back for a second time, but he was there at the time he said he was. Chalk one up for Dr. Miller. The license was issued to Ted Thorpe and the call sign was ZK2AF.

In a letter from ZK2AE, he tells me someone has been bootlegging his call. Harry is the only ham operating from Niue at the present time and is active only on 75 meter AM! He has been receiving cards for SSB contacts on other bands and would like this clarified. One card said the signal had come in from a heading toward South America. Harry says, "Unless we accidentally got moved into the South Atlantic by General De Gaulle playing with fireworks not far away. we are still where we should be (Longitude 169° 50' W and Latitude 19° S)." He also mentions that he is awaiting a SB400 from Heathkit, and if it ever arrives he will be available to give all of you that needed ZK2 card.

... WØHJL





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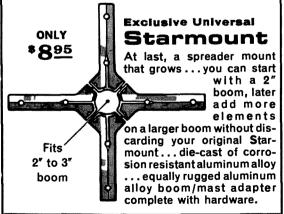
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More AM/SSB

Dear 73.

... I'd like to congratulate you on your editorial in the June issue. It is about time someone had the fortitude to present a case against "Ancient Modulation". It would be wonderful if someone proposed to the FCC that a law be made outlawing A3 operation, say in two years. That would give the few diehards plenty of opportunity and time to make the change-over. That such a ruling is going to be necessary is a certainty. There will always be a few individuals that will hang on to the last, regardless of the fact that AM is spectrum wasting and less efficient than side-hand.

Joe Hiller W40PM Virginia Beach, Virginia

Be careful about saying A3, Joe . . . SSB is also A3!

Dear 73.

Your editorial on SSB and AM has certainly raised some eyebrows. Whether or not I agree with your opinions is immaterial; I congratulate you for taking a definite stand on the issue.

Jack Dolconrt Lakewood, Colorado

Dear 73,

... DTY says he is not advocating appliance operating. If he isn't then I must have read his articles wrong, because unless a new ham has a fat wallet, what chance has he of going to SSB? I don't think there are many hams starting out in the hobby that are technically qualified to build a SSB rig on his first home-brew project. This is usually worked up by building a few CW and AM rigs first and learning along the way. The man who can lay a thousand bucks on the counter, take home and plug in his appliances, and as NSD says, make a noise that can be heard around the world sixteen hours a day, is nothing more than a high-power CB'er with ham privileges. There should be more to our hobby than flicking a couple of switches and talking.

... My subscription has over a year to go yet, but unless your magazine adopts a more tolerant and responsible policy, I am going back to the competition, whose magazine is not so good, but their policy is easier to swallow.

Bob Young VE3FCW Fruitland, Ontario

Dear 73.

Since you wish to eliminate all AM I can well do without ur 73. At 76 years of age, I am not investing in rigs that may well be obsolete (SSB) in 5 years or so. Of course you are so BIG now that losing a few thousand old timers don't matter. W1DTY is going to help you a lot—or is he? I serve MARS about 80 hours a month on AM and doubt if he is serving his country that much on SSB.

Bruce O. Cline Christiana, Tennessee

MARS has eliminated AM operation on all frequencies except VHF.

Dear 73.

... It seems to me the idea of eliminating AM phone is contrary to the principles 73 has stood for in the past—that is, home brew and non-appliance gear? What about the new ham? what about the fellow to whom \$100 is a lot of money? There was a day when a fellow could get on phone with an 807 and an ARC-5 and have lots of fun. To eliminate AM would be to force the inexperienced ham and the fellow who isn't rich to forfeit half the fun of ham radio.

... Why not allot the high end of the 10 meter phone band to AM phone only, for novice and general alike, especially since most SSB gear these days won't go up there anyway?

Clarence Wager K6TBW Paradise, California

Dear 73.

Just received my August 73... I enjoyed very much the "letters" section and had a couple of good laughs under "SSB vs. AM". Who are those "Ancient Mariners" trying to kid? "SSB is on the way out"; "DSB would defeat SSB"; etc. AM is a nice way of communication but people who make remarks like that are either selfish or ignorant. Selfish, because they like blanking out 10 kc (at least) with their FB carrier . . . and ignorant because they don't appreciate what SSB has over AM.

Mike W. Palawaga VE5PI/3 Ottawa, Ontario

Dear 73,

After reading the comments on "The View From Here" by W1DTY, I want to say I have nothing personal against Jim, but I think you should keep your editorials neutral about AM and SSB. That is why I dropped QST and CQ. I have talked to a great number of prospective hams and here is a general view of what they tell me: "We are very much interested in amateur radio, but we cannot afford to buy commercial transmitters or transceivers and what is the use of getting or building an AM rig when all the radio magazines are against our using AM? . . . it isn't worth while, so we are going CB".

Of course I know you won't believe this because your mind is fixed and nothing will change it. I'm not going to get anything beyond a General, so I will go on 10-6-2 later. I don't like the minority that tries to force the majority... or else.

Edgar J. Bowser Rumford, Rhode Island

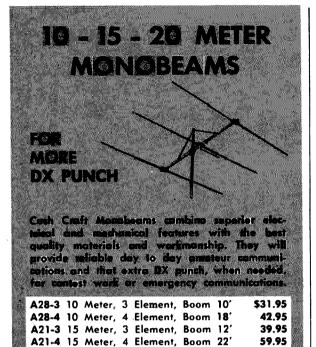
Dear 73.

... It is editorials like yours that are going to split the amateur radio fraternity into two warring parties, each bent on destroying the other. Evidence of this can be seen already on the bands and it is getting worse all the time.

I could care less if SSB is more efficient than AM. If you want to get nasty, I could spend hours listing the advantages of CW over SSB and could even advocate the elimination of phone altogether.

Amateur radio must stay together to work towards a common goal, and fighting on or off the bands is not helping to further amateur radio.

> Michael F. McCrackin WB6SCV Anaheim, California





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The DXERS MAGAZINE c/o W4 BPD

Route 1, Box 161-A Cordova, S.C., U.S.A. Dear 73.

I hope you don't mind long letters because I am afraid this is going to be a long one.

First of all, the AM vs SSB controversy. I person-

ally think that AM should be outlawed on 80 through 10 meters. On 160 and the VHF bands it is ok. I want to quote from the *NAB Engineering Handbook, 5th Edition. This is what it says about CSSB (Compatible Single Sideband).

- 1. An effective 2 to 1 power gain for a given signal fidelity.
- 2. A reduction in adjacent and co-channel interference
- 3. A reduction in certain types of selective fading distortion.
- 4. A potential improvement in audio fidelity which, besides improving reception of musical programs, improved intelligibility of speech, thus increasing service range.
- 5. A reduction in television-receiver radiation interference.

I don't know if you know this, but three broadcast stations in 1958 were using CSSB. They are KDKA, Pittsburgh; WABC, New York; and WSN, Nashville; with KBIG, Catalina Island adding it later. This fact was not too well publicized. There are probably more stations using it now. CSSB is quite similar to standard AM transmission, except that the spectrum energy is concentrated on one side of the carrier (thus making it possible for the little table top radio to receive the broadcasts).

This quote from the NAB is what KDKA says about CSSB.

"The chief gain to KDKA of using CSSB is the reduction of adjacent channel interference between KDKA on 1020 kHz and WBZ in Boston on 1030 kHz. The removal of KDKA's upper side frequencies has relieved interference to WBZ's reception, and the ability of receivers tuned to KDKA to tune slightly off resonance away from WBZ and toward the radiated lower sideband of KDKA has also given KDKA some

additional immunity from WBZ.

Next, please don't cut down on CW saying it is outmoded. Maybe it is, but there is one thing that most confirmed CW addicts will tell you and that is that CW is fun. Another thing, don't let anyone tell you that the 20-meter CW band is 14.000 to 14.200. It's not! It is 14.000 to about 14.080. RTTY from 14.080 to 14.100, and foreign SSB from 14.100 to 14.200. No argument intended; just a fact.

One more thing, please look into this Don Miller thing. I heard him talk down at the Dayton Hamvention and I don't think too much of him.

> Charles Collingwood WASPVN Findlay, Ohio

*National Association of Broadcasters.

Dear 73.

Well, you really did it this time! Technically speaking, there can be no question about the fact that SSB is superior. It is, and any engineer can prove it. But that still doesn't mean that all of the AM boys should be shot out of the saddle. In spite of the popular rumor, the bands are not that crowded . . . yet.

. Wayne stubbed his toe in September 73 also. In his DX'ing article it sounds like Wayne is secretly advocating illegal overpower operation. Assuming proper operation and reasonable efficiency, since when is a "big" 2000 W PEP any stronger than a "small" 2000 W PEP? Of course the FCC measures average power, and there is a difference. Wayne can't tell me that he doesn't know that a large number of the boys with the "big" kilowatts are habitually running over the legal limit.

Oh, yes, I'll renew. It's still a good rag.

William J. English WA4RME Miami, Florida

Dear 73.

. . . Maybe the AM operators who don't know enough to build a sideband transmitter should have a march on Washington . . . and turn in their licenses. And, for that matter, so should a lot of SSB operators. The ones who don't even know how their transmitters work. Oh, sure, they know it has a crystal filter (maybe) and it has audio phase shift network (maybe), but they don't even know what the words mean.

Anyone who thinks a sideband transmitter has to cost 30 dB above 1 dollar (that is calculated by 10 log because money is power), drop me a post card (6 dB above a penny is what they cost), and I'll send you plans for a sideband rig you can build for \$25.

Re your August editorial . . . all you hams out there who start yelling about novices on 10 meters; don't yell! It's a great idea. Maybe we can get some operation on 10, and if we get it, maybe, just maybe, 10 meters won't go the same as 11 meters did.

Give the novices part of 10 meters. Let them run 75 watts on AM and CW, extend the license for 2 years and SAVE 10 meters.

Joe Hollan W4BGN/3 Annapolis, Maryland

Dear 73

I just finished thumbing through the September issue of your magazine, and was inspired to write this letter on the AM-Sideband feud. I believe that both modes have their place, but what about NBFM, FM, PM, and ultra narrow band FM (160 Hz wide)? Surely these modes are compatible, especially on VHF. But the simplest fact is that you hear very few stations using these modes. I feel sure that bands like 160 meters are ideal for Ultra NBFM. Because it is FM it is not susceptible to QRN and LORAN, and because it is narrow band, it prevents QRM to other stations.

What is happening to the ham community, are we satisfied to fued over SSB and AM, and not even try to use the other modes of operation offered to us?

Carl Russo WA1BOZ Waltham, Massachusetts

Dear 73,

I agree that SSB has it's distinct advantages; however, I do not feel that it is right to completely eliminate AM from the specified bands. I think SSB'ers should have half of each band to themselves, and AM'ers the other half. Many hams already follow this unwritten law.

Alex Arevalo WA5MZU San Antonio, Texas

Dear 73,

In reading your article in the July '67 73—you want to know why there are not many taking an interest in ham radio? Well, I would like to be one, but I find I can't quite do 13 words a minute. Written test—not so bad. Maybe that's why I joined the CB's too.

Just a reader of 73 magazine Lansing, Michigan

QSLs

Dear 73,

Like many others, I used to sit at the home QTH and complain about how the DX never QSLs. When I arrived in Scotland, I swore that I would QSL 100%, for sure, After six months of operation, I've had a chance to see the American ham in operation. Keeping in mind that GM-land is hardly rare DX, here is how the Ws stack up so far with me.

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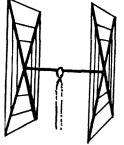


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... So far I have sent out over 1400 cards and have received some 350. Like most of the boys here, I will continue to send them out when requested, plus or minus a mistake now and then. All most of us ask is that you do not say you will QSL and then don't. A QSL is never required for a QSO. After having a ticket 18 years, I do not suddenly expect 100% return, but do expect the boys to keep this in mind when they complain.

> Doc Kelly GM5AFF/W7NXJ Edzell Angus, Scotland

Bouquets, etc.

Dear 73.

I should send you a doctor's bill for getting my eyes uncrossed over that up-side-down figure on page 15 of the August issue, but the Army did it for free, and besides, the article on "Designing Transistor Oscillators" cured several headaches for me, so we are even. Aside from the ramblings, I feel that you are doing a tremendous job in the electronic field in the state-ofthe-art department. Just reading your fine articles is an education. I don't know if you are getting the fine authors because you are tops in publications, or if you are tops in publications because you get fine authors. Don't care. Just keep it up.

> Glenn H. Kuklewski K8UST Huntington, West Virginia

Dear 73.

Thank you for your fine magazine, and for Heaven's sake, don't ever publish the kind of trash the other two do.

> Michael Mladejovsky WA7ARK Salt Lake City, Utah

Dear 73.

Covers like the one on 73, August 1967, and articles like 'Climbing the Novice Ladder" make me say 73 to 73.

> Jon Fortune WN1TTO Reynolds, Illinois

Dear 73,

I have just read my first copy of your magazine and as far as I'm concerned it is one of the best magazines I have ever come across. I find the articles excellent, and appreciate the fact that you have both American and Canadian authors.

Although I am only a ham to be, I have been studying amateur regulations and procedure for three years. I feel that Jim Fisk's editorial on the decrease in the number of amateurs and lack of publicity for amateur radio is much more serious than meets the eye. The one thing Jim's letter has going for him is the urgent need for more electronics technicians. However, I feel that what would be more beneficial to amateurs at the present time, would be to raise the interest level for amateur radio in other countries.

From what I gather, every country has one vote at the Geneva convention as far as the frequency allocations are concerned. If there is a sufficient number of countries who vote for the withdrawal of amateur stations from certain frequencies, then the present crowding conditions will worsen. If the countries concerned could be shown the benefits and advantages of having amateur radio, they may be more willing to promote it.

I therefore feel that it is up to us, the amateurs (I'll be included soon) to firstly publicize amateur radio in other countries to get their support, and then to publicize in our own countries.

> Ronald Rosmer Salmon Arm, B.C., Canada

Dear 73.

Why are we so concerned about what the manufacturers believe is right for amateur radio? Was it they that made ham radio possible? As far as I am concerned they should stay on their side of the line and just continue to sell equipment to those wishing to purchase their products. They should stay clear out of amateur radio politics unless asked for an occasional opinion or comment.

It will not be the manufacturers who will pull amateur radio through the next Geneva Conference but it must be us amateurs ourselves. And we had better get to work and support, petition and uphold both the ARRL and FCC in these matters.

The manufacturer has a primary interest in the mobile radio services (police-fire-taxi) and will not place amateur radio or even CB for that matter, ahead of a more profitable business. They are fighting us now for more frequencies.

> Gary L. Carlson KL7FRZ Haines, Alaska

Public Service . . .

Dear 73.

Last evening when I tuned in the radio there had been a previous call thanking a ham operator for some service. While I was listening, someone called and gave your address and said you would be happy to hear any comments.

My niece's husband volunteered to go to Antarctica for one year to further the study of meteorology for the US Government. Each week, through the kindness of a ham operator, my niece was able to talk to her husband by telephone, sometimes for as long as a half hour, and at the cost of a local telephone call. Needless to say, these calls were a Godsend, not only to my niece's husband to learn about the family first hand, but to all other men when they received an opportunity to talk to someone from their own homes.

Keep up the good work and do want you to know how much we all appreciate the great kindness and generosity of these good ham operators.

> Margaret Sammon Arlington, Massachusetts

Dear 73.

I wish to inform you of a service rendered my family by a ham operator. The operator, George Jette WIUE of Wellfleet, Mass., called our home to tell us that he had received a message from our son who is attached to the USS Forestall. The message informed us that he was OK and would write soon. Of course we were elated as we had been waiting anxiously for word as to his well being since the disastrous fire. Once again, I would like to say how much we appreciate the above service.

> Mr. A. Martin and family Maiden, Massachusetts

Thanks go to several Boston area radio stations who have been giving us some nice publicity recently.



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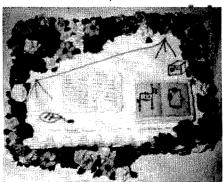
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Dear 73.

Our club regularly conducts free Novice, General, and Extra Class courses. At the concluding session of our last course, one of our student supplied the cake shown in the accompaning picture to celebrate the successful completion of the course. He and his wife baked and decorated the cake for the group . . . we thought this might be of interest and might stimulate interest in running courses in a few other clubs.

Marie R. Welch WA6VTM, President LERC Amateur Radio Club W6LS Burbank, California



Gee fellows, you are doing a great job with 73 Magazine. For my money it's the best. In fact 73 has eliminated all other ham magazines from my mail box. Other subscriptions are checked at the book store and seldom do we have to buy brand X because it has been covered in some issue of 73.

However, anyone who plays with electronics will soon have a short circuit. Even when writing about electronics, it is possible to develop short circuits.

If you will refer to August 1967 73 on page 115 you will find a very fine article by Jan Underdown, K8LUR of Napolean, Ohio. While Jan's article on phone patching is very timely and informative, I just can't buy his call letters. I'm K8LUR. Where's the short circuit?

> Walt Wilkerson K8LUR Elkins, West Virginia

Sorry about that Walt, Jan Underdown is K8LVR.

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Dr. Miller?

Dear 73,

With interest I read your write-up on Don Miller W9WNV in the July 1967 issue . . . With reference to Don's DXpedition to the Laccadives, my comments are as under:

a) In August 1966, I asked the Government of India for permission to operate from the Laccadives for a second time. After several reminders, I was given

the hint-"No permission".

b) In January 1967, I was told that Don had been to the Laccadives and operated from there. I took up the matter, through our Society, and questioned my government for refusing me permission while granting the same to a foreigner.

c) The Licensing authorities here categorically denied having issued permission to any foreigner to operate from the Laccadives. Consequently the Editor of the IRA intimated to the ARRL about Don's "Mischievous operation" from the Laccadives. This was done to warn other hams not to flout rules and regulations of a country and indulge in such unauthorized activities which might ultimately endanger the Reciprocal Agreements.

d) Thereupon the ARRL sent us a photostat copy of an authority, presumably issued by our government, which permitted Don to operate from the Laccadives. With this photostat copy we rushed to our licensing authorities for their comments—we were

furious!

e) Detailed investigations of the police, customs, and port authorities confirmed that no operation was carried out from the Laccadives and the photostat copy submitted by Don Miller was a "Forged document". Investigations also confirmed that for this purpose, Don used a letter issued by this Government about three years back. To reveal facts, the Licensing Office in this country has long been redesignated and the officer whose signature appeared on the document has not handled Amateur License portfolio for the last three years. Our government has addressed a letter to ARRL giving all the information in this regard.

Needless to say that in this part of the world, we amateurs do not attach importance as the W/K boys do to this facet of ham radio viz., DX hunting. However, in 1961, I carried out the first DX pedition to the Laccadives and recently I had been trying to go over there once again but failed to obtain permission in spite of my being an official in the Ministry itself. As such, there is no question of my trying to out-maneuver Don in his sport.

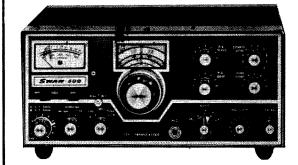
Besides, for the last eight months, no fresh licenses have been issued to hams in this country, the policy being under review. Hence, any operation by Don Miller from the Laccadives would again be nothing but "fraud". Thus far, we were avoiding any sort of write-up on Don's Laccadives operation in the IRA but now the situation demands it and the next issue shall bear a write-up on this vital subject.

B.A.N. Raju VU2NR New Delhi, India

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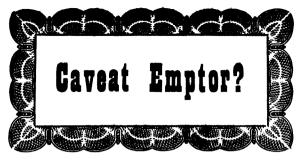
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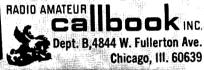
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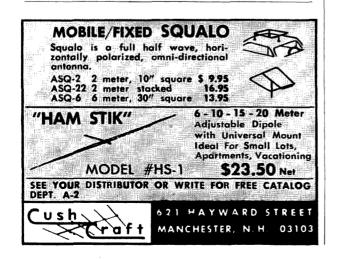
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DECEMBER 1967

AMATEUR RADIO



73 Magazine

December 1967

Vol. XLVI No. 12

Jim Fisk WIDTY Editor

Kayla Bloom WØHJL Assistant Editor

Published by Wayne Green, W2NSD/I

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I have talked to several hundred amateurs since the new Incentive Licensing Law was announced in late August, and except for one very vociferous individual whom I met in Los Angeles, there has been a noticeable absence of complaints. In general the amateurs have accepted the new rules in good grace and are setting to work on their code speed and theory.

That is not to say that they're all that happy with it. But then, whenever you add requirements to any task, there is bound to be a certain amount of rebellion. That's just natural. However, most individuals will take it all in stride and get on with the task at hand.

Still, there are those hams who ask why. Perhaps the biggest reason is PICON, "public interest, convenience or necessity", which is spelled out in the Communications Act of 1934. This is covered in paragraph 97.1 (c) of the amateur regulations: "Encouragement and improvement of the amateur radio service through rules which provide for advancing skills in both the communications and technical phases of the art."

In fact, I am a perfect example of the need for incentive licensing. If you check the latest edition of the *Radio Amateur Call*-

book, you'll find a great big "C" beside my name, indicating a Conditional class license. I never needed anything else, so I never went to the trouble to try for a higher class. Why in fact should I even take the General exam? I already had all the privileges that are available.

However, since I was going to lose a good deal of my operating privileges under the new regulations unless I took the Extra exam, I had to stop procrastinating. And, since I held a Conditional license, I had a pretty good row to hoe. I'm happy to say I made the grade on October 27th. If I was primarily a phone operator, I would probably have waited for the Advanced test, but since I spend about 80% of my operating on CW, the Extra class is a must. Not that it's all that difficult.

Admittedly, there are a few individuals who have trouble with the code. However, and you tnay not believe this, if you can take 13 words per minute, the odds that you can't take 20 wpm are pretty remote. Tests indicate that up to about ten words per minute, you don't actually "copy" code, you write it. At 13 wpm you actually have to copy it letter by letter because there isn't sufficient time to count the individual dots and dashes in each character. Below 10 wpm you can get away with counting the dots and dashes.

This is borne out by records in the various military radio operator schools. The majority of the fellows who don't make it drop out at the jump from 10 to 13 wpm. And, if they can make 13, they inevitably can increase their speed. It takes some longer than others, but with practice nearly all of them can get up to 20 words per minute.

I'm afraid that I can't offer the same amount of encouragement to the Technicians. In many cases they will never get over the five word-per-minute hurdle. There are a lot of factors involved, but if you can copy five, you can't necessarily get to 13. And I have yet to see someone who could not be taught to take five words per minute. There is even one case on record where a chimpanzee was taught how!

Incidentally, for my unknown friends from San Antonio who want to know how I qualified for the "box-top" license, it's very simple: I was a radio operator with the 7th Division in Korea when I applied.

. . . Jim Fisk W1DTY
Extra Class

A .25 MHz to 29.75 MHz Stabilized Converter

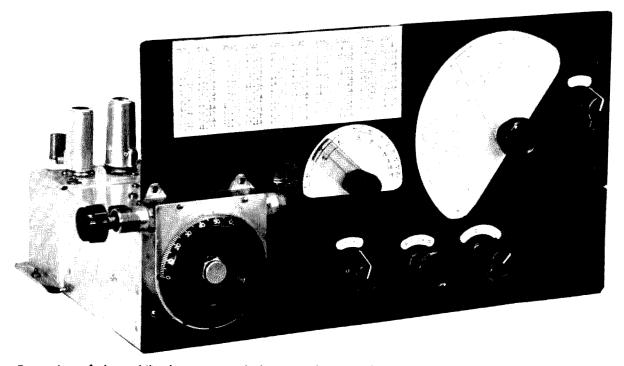
There are many advantages to the hambands only receiver. Good stability, a slow tuning rate, and accurate calibration are common in these receivers. Their greatest disadvantage is that they tune only a small portion of the spectrum below 30 MHz. This converter was designed to eliminate this disadvantage by converting all frequencies from .25 MHz to 29.75 MHz to the output frequency of 3.5 MHz to 4.0 MHz. This is done with little loss of stability or calibration accuracy.

The 29.5 MHz range is covered in 59 bands, each 500 kHz wide. Forty-four local oscillator frequencies are used. The local oscillator is above the signal from .25 MHz to 7.75 MHz, and below the signal from 7.75 MHz to 29.75 MHz. The local oscillator is a vfo which is stabilized at the proper output frequencies with an afc circuit. The main frequency-determining parts of this circuit are

a 1 MHz crystal oscillator and a 1.75 MHz phase-shift discriminator, both of which are quite stable.

The afc loop doesn't have enough gain to lock exactly on frequency, but with reasonable care in tuning, the error will be no more than a kilohertz or so. The warm-up drift is about 2.4 kHz at 28 MHz and about 1.3 kHz at 2 MHz. Most of the drift takes place in the first 10 minutes after turn on, and after about 20 minutes the drift is too slight for me to measure.

With an output frequency of 3.5 MHz to 4.0 MHz, all of the bands begin and end at the .25 MHz and .75 MHz points. This is a minor inconvenience when tuning some bands. The bands would begin and end at the .5 MHz and 1 MHz points if the output frequency were changed to 3.75 MHz to 4.25 MHz, but this wasn't convenient with the receiver I use.



Front view of the stabilized converter which covers from 500 kHz to 29.75 MHz. The dial on the left is the tuning dial, the one in the middle is set according to the chart and the dial on the far right is the preselector.

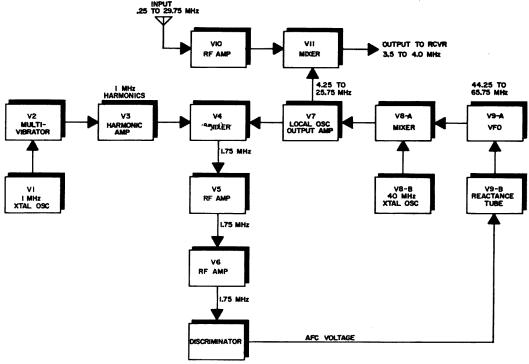


Fig. 1. Block diagram of the wideband converter which covers from 500 kHz to 29.5 MHz. A complete description of its operation is given in the text.

Theory of operation

The local oscillator operates in the following manner. Refer to the block diagram, Fig. 1. V1 is a crystal oscillator operating at 1 MHz and is capable of being zeroed with WWV. This 1 MHz signal is fed into a multivibrator, V2, to increase its harmonic content. The output of V2 is fed into a wideband amplifier, V3, to increase the level of the higher harmonics. These 1 MHz harmonics then go to one input of V4, a pentagrid mixer. The vfo, V9a, is continuously tunable from 44.25 MHz to 65.75 MHz. The vfo output goes to a triode mixer, V8a, where it is mixed with the 40 MHz output of V8b, which is an overtone crystal oscillator.

The difference frequency is selected and amplified by V7 to get an output of 4.25 MHz to 25.75 MHz, which goes to the other input of the pentagrid mixer, V4, and is also the local oscillator output to the converter. The output of the mixer, V4, is tuned to 1.75 MHz and is amplified by V5 and V6. The output of V6 goes to a Foster-Seely type discriminator with a center frequency of 1.75 MHz. The diodes in this circuit are reversible by means of a switch to give the proper output polarity.

When the incoming frequency is exactly 1.75 MHz the output of the discriminator is zero. When the frequency is greater than 1.75

MHz there will be a dc output voltage from the discriminator, and when the frequency is less than 1.75 MHz there will be a dc output voltage of the opposite polarity. This is the control voltage which goes to V9b, a reactance tube which has the effect of shunting a capacitance across the vfo tuned circuit. The amount of capacitance is determined by the discriminator output voltage, so it follows that the vfo frequency can be controlled in some extent by the frequency of the signal input to the discriminator.

As the vfo is tuned through its range, the 4.25 MHz to 25.75 MHz output of V7 beats with the 1 MHz harmonics in V4 to produce the 1.75 MHz output at .5 MHz intervals. For example, when the vfo output is 4.25 MHz it beats with the sixth 1 MHz harmonic at 6 MHz to give a difference frequency of 1.75 MHz. When the vfo is moved up .5 MHz to 4.75 MHz it beats with the 3 MHz harmonic to give the difference frequency of 1.75 MHz, and so on throughout the tuning range. As the vfo is moved up through its range, at each consecutive .5 MHz interval it mixes alternately with a 1 MHz harmonic which is either 1.75 MHz above or 1.75 MHz below the vfo output frequency. This alternate use of 1 MHz harmonics above and below the vfo frequency is the reason for the diode switching in the

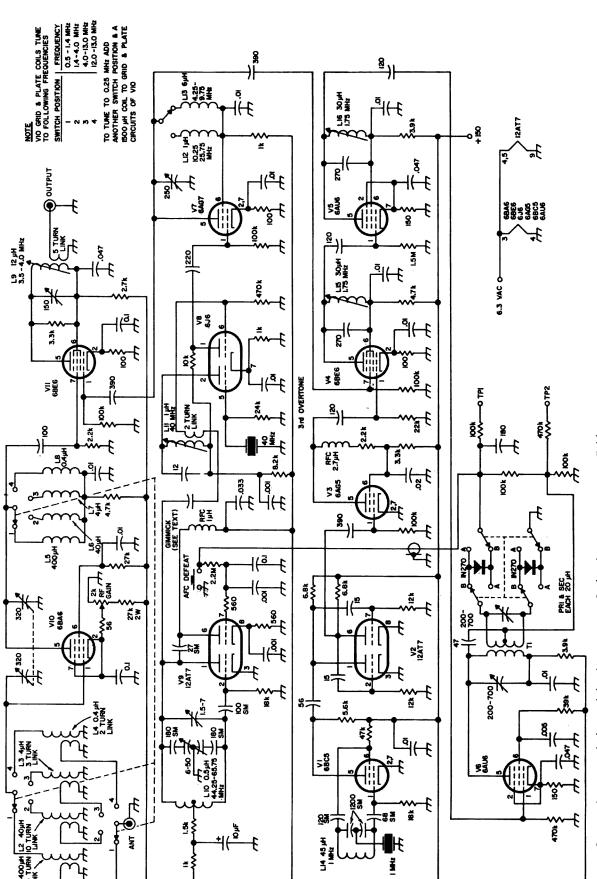


Fig. 2. Circuit diagram of the stabilized converter. Coil values are given in Table 1.

discriminator output. This maintains the proper polarity of afc voltage needed to lock

the vfo on frequency.

When the vfo is tuned to within 25 kHz or so of the right frequency the afc action of the discriminator and reactance tube will tend to pull the oscillator to an exact 0.5 MHz interval and correct for any drift or slight mistuning. This afc action is not perfect but with average care in timing, the error can be kept to less than 2 kHz. If a meter is used to monitor the discriminator output voltage and is kept zeroed, the only error will be caused by drift in the 1 MHz oscillator or drift in the 1.75 MHz discriminator circuit, both of which can be made very slight.

A vfo in the VHF region is used so that the reactance tube will have a considerable effect on the frequency of oscillation. It also enables you to cover the entire range without any switching in the oscillator circuit.

Construction

This unit was built almost entirely from the junkbox. The circuits are simple and nothing seems to be critical. The vfo, high-frequency mixer, and local oscillator output amplifier are built on a 5 x 7 x 3 inch aluminum chassis, and the converter is built on another the same size. The locking circuit is built into four small stirplus aluminum boxes. Using a separate chassis is a simple way of providing good shielding, which helps to reduce spurious signals.

The vfo is tuned with a Bud No. LC1662 dual capacitor with 6-50 pF per section. It works well enough but the straight-line capacity causes crowding at the high frequency end of the dial. The dial is from a BC-429 receiver. It has a nice slow 120 to 1 ratio, but the 0 to 100 calibration leaves something to be desired. The coil is wound on a inch diameter ceramic form. A 1.5-7 pF ceramic trimmer and two 180 pF silver mica padders were used to spread the tuning range over most of the dial. This circuit should be built for maximum mechanical stability.

In the reactance tube circuit, the 1 µH RFC and the 560 ohm grid resistor were found experimentally to give the greatest frequency swing.

The high frequency mixer, V8a, is coupled to the vfo by wrapping several turns of insulated wire around the vfo plate lead, and is coupled to the 40 MHz oscillator with a two turn link around the oscillator

coil.

The local oscillator output amplifier, V7, is tuned with one section of a two gang variable, the other section not being used. It is from surplus and has a maximum capacity of 250 pF. The coils are wound on inch diameter plastic tubing. Two coils are needed to cover the tuning range of 4.25 MHz to 25.75 MHz.

The 1 MHz oscillator uses a series resonant CR-19/U crystal. This requires a tuned circuit in the oscillator. The coil is wound on a %" diameter ceramic form. I tuned the circuit to resonance by pruning the coil. A trimmer capacitor could be used for easier adjustment.

The multivibrator, V2, synchronizes easily with the crystal oscillator using the parts values given. If you change some of the values be sure the free-running frequency is close enough to 1 MHz to sync properly.

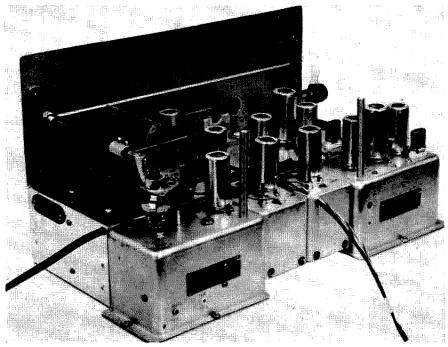
The harmonic amplifier, V3, is a crude type of wide band amplifier. The 2.7 µH RFC and the 2200 ohm resistor in the plate circuit were chosen by trial and error to give some amplification of the higher 1 MHz harmonics without attenuating the lower frequencies.

In the low frequency mixer, V4, the plate coil is wound on a % inch diameter iron slug tuned form taken from an old TV set, as is the plate coil in the 1.75 MHz amplifier, V5. There should be no regeneration in the 1.75 MHz amplifiers or the bandwidth may become too narrow for easy locking of the afc

Table I. Coil data for the stabilized converter.

- L1, L5 —175 turns no. 30, 1-1/16" diameter, close wound.
- L2, L6 —50 turns no. 30, 34" diameter, close wound.
- L3, L7 -15 turns no. 26, $\frac{3}{4}$ " diameter, $\frac{1}{2}$ " long.
- L4, L8 —5 turns, no. 20, 3/4" diameter, 1/2" long.
- L9 —50 turns no. 30, 1/4" diameter, 1/2" long, scramble wound.
- L10, —8 turns no. 18, 1/2" diameter, 3/4" long, center tapped.
- LII —20 turns no. 26, 1/4" diameter, close wound.
- L12 —6 turns no. 26, 3/4" diameter, 3/8" long.
- L13 —22 turns no. 26, 3/4" diameter, 3/4" long.
- L14 —52 turns no. 30, 7/8" diameter, close wound.
- L15, L16—75 turns no. 30, 1/4" diameter, 1/2" long, scramble wound.
- TI —Primary 45 turns no. 30, 1/2" diameter, close wound. Secondary 45 turns fio. 30, center tapped, close wound. 1/2" space between windings.

Rear view of the wideband converter. The chassis is made up from six smaller chassis—this provides modular construction and shielding between stages. The coaxial cable to the left connects into the station receiver; the wires from the rear furnish power.



loop.

The discriminator coil is wound on a ½ inch diameter plastic form taken from an old TV set. The tuning capacitors are mica compression type trimmers. The capacity required is about 450 pF. This probably should be made up of a fixed silver mica in parallel with an air trimmer for tuning, as this is one of the main frequency-determining circuits. However, in the original circuit frequency drift is negligible. 1N270 diodes were used because they were on hand. Any of the small signal germanium diodes should work well.

The diode reversing switch is a ceramic rotary from surplus. It is actuated through a right angle gear drive taken from a surplus tuning drive. The dc output should be run through a shielded wire to the reactance tube to avoid hum pickup. TP1 and TP2 are phone tip jacks used as test points for aligning the 1.75 MHz stages.

The converter, consisting of the rf amplifier, V10, and the mixer, V11, is conventional. The grid and plate circuits of the rf amplifier are tuned with 2 sections of a 3 gang variable capacitor taken from an old car radio. The shielding between the two tuned circuits is inadequate in this unit, which made it necessary to load the output circuit with a 2200 ohm mixer grid resistor to prevent oscillation. The lowest frequency tuned is 500 kHz, but this can be extended to 250 kHz, if desired, by adding another switch position and two more coils. The mixer output coil is wound on a ¼ inch diameter iron

slug tuned form from an old TV set. It is loaded with a 3300 ohm resistor to broaden the bandwidth and gives a reasonably flat response across the band.

Alignment and calibration

The equipment required for alignment and calibration is a grid dip meter, a receiver covering from 3.5 MHz to 30 MHz, a 100 kHz crystal calibrator, and a 50 µA meter or a vtvm. The most difficult job is calibrating the vfo. Start by checking the tuning range with the grid dip meter and adjust the trimmer and padders or prune the coil until the range of 44.25 MHz to 65.75 MHz covers most of the dial. Apply filament and plate voltage to V8 and V9 and adjust the 40 MHz oscillator coil slug for maximum output consistent with good starting. Check for output and proper frequency with the grid dip meter in the diode position. Ground the grid of the reactance tube temporarily, or close the afc defeat switch.

With the vfo and the 40 MHz oscillator working properly, lightly couple the plate of the high frequency mixer (pin 1 of V8) to the receiver by bringing a short antenna wire nearby. Calibrate the vfo (vfo frequency minus 40 MHz) as accurately as possible to the .25 MHz and .75 MHz points from 4.25 MHz to 25.75 MHz. I calibrated by 0 to 100 dial to the nearest tenth of a division and made a chart listing the frequency and dial reading.

Apply filament and plate voltage to the

local oscillator output amplifier, V7, and filament voltage to V4 and V11. For a resonance indicator measure the grid voltage of V4 (pin 7) through an isolating resistor. Calibrate the tuning of V7 at enough spots so that it may be set close to the mixer output frequencies (4.25 MHz to 25.75 MHz) without use of the meter.

With all voltages removed, pre-tune the 1.75 MHz output circuits of V4 and V5 with the grid dip meter. Pre-tune the discriminator transformer by shorting out the secondary with a short jumper and dipping the primary to resonance. Remove the jumper from the secondary and place it across the primary and dip the secondary to resonance. Remove the jumper from the circuit and apply filament and plate voltage to V5 and V6. Connect a 50 μ A meter or vtvm between test point 2 and ground. Inject a small amount of 1.75 MHz rf into the output coil of V4 with the grid dip oscillator.

To insure accuracy tune the receiver to 3.5 MHz and zero beat the second harmonic of the grid dip oscillator with the crystal calibrator. Tune the output coils of V4 and V5 and the primary of the discriminator transformer for maximum voltage at test point 2. Connect the meter to test point 1 and adjust the secondary of the discriminator transform-

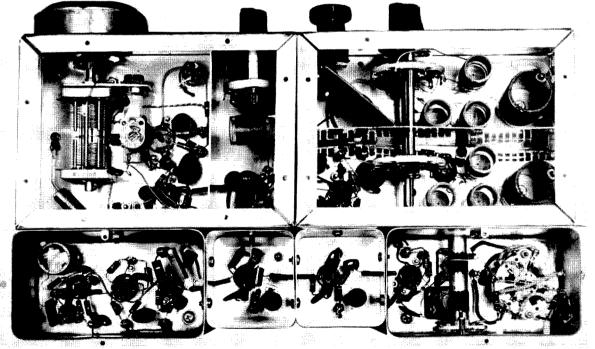
er for zero output at exactly 1.75 MHz. Moving the grid dip oscillator frequency above and below 1.75 MHz should swing the output voltage above and below zero. The output polarity should reverse when the diode reversing switch is thrown.

Check the 1 MHz crystal oscillator for proper operation and adjust it for zero beat with WWV. Check the free-running frequency of the multivibrator by listening to it or its harmonics on the receiver. It should be within 100 kHz or so of 1 MHz to insure proper synchronization. The operation of the harmonic amplifier can be checked by listening to the 1 MHz harmonics above 20 MHz with the amplifier in and out of the circuit.

The plate coil of the mixer, VII, can be tuned to resonance at about 3.75 MHz with the grid dip meter.

I calibrated the rf amplifier, V10, after everything else was working properly. I started with the lowest frequency band and went through the entire range, first setting the local oscillator and the receiver to the desired frequency and then tuning the rf amplifier for maximum noise. A signal generator or the grid dip oscillator could also be used.

Some kind of charts or graphs are necessary to convert the receiver dial reading to



Wiring of the converter. The chassis in the upper right contains the rf amplifier circuitry. The upper lefthand chassis contains the vfo and 3.5-4.0 MHz output stage. The four small chassis on the bottom are, from the left, I MHz crystal-controlled reference and harmonic generator, two amplifier stages and the 1.75 MHz frequency discriminator.



Leonard Norman, W7PBV, Chairman

JAN. 4, 5, 6, 7, 1968

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the actual received frequency. Four conversions are needed: below 7.75 MHz (reverse tuning) in "A" diode switch position; below 7.75 MHz in "B" diode switch position; above 7.75 MHz (forward tuning) in "A" diode switch position; and above 7.75 MHz in "B" diode switch position. I use a slide rule type scale drawn on graph paper with the receiver dial reading above the line and the corrected reading below the line. The tuning charts are not necessary for most general listening. It is usually enough just to know the center frequency and whether the tuning is forward or backward.

Operation

Operation of the completed converter is simple. The vfo is first tuned carefully to the proper frequency. Then the local oscillator output tuning and the rf amplifier tuning dials are set and the diode reversing switch is set to the proper position. With the discriminator diodes and the reversing switch wired as shown, the "A" position is used for properly locking to the .25 MHz local oscillator frequency points, and the "B" position for the .75 MHz points. The afc defeat switch is then momentarily closed to let the vfo return to its natural frequency. When the afc defeat switch is opened the converter will lock on frequency and be ready for use. The rf amplifier is sharp tuning and will have to be peaked up several times when tuning across a band. The converter should not be used from 3.5 MHz to 4.0 MHz because of direct feed through of signals to the receiver. To tune 3.5 MHz to 4.0 MHz without disconnecting the converter, the local oscillator can be set to some other band with the rf amplifier tuned to 3.5 MHz to 4.0 MHz, thereby using the converter as a preselector.

There are three strong spurious signals in the output of the converter. These are at exactly 3.5 MHz, 3.75 MHz, and 4.0 MHz. They are seldom bothersome and provide useful marker signals. Any incoming signal that is zero beat with these signals, such as WWV, is easily heard.

The power required is 150 Vdc at 85 mA, and 6.3 Vac at 3.5 A. The plate voltage to the vfo and the reactance tube should be regulated.

The idea for using a VHF vfo came from the British Racal receiver. The afc circuit is similar to that used for stabilizing some types of FM transmitters.

... K5LLI

Some Experiments with Stacked Beams

For the amateur interested in DX, both the power output of the transmitter and the type of antenna used will be of prime importance in getting a signal to the desired location. Neglecting for the time being the general characteristics of the receiver itself, the antenna becomes equally important in reception of long-distant communications. In the pursuit of a rare DX contact, the frequency will, more often than not be jammed with stations who are running the legal limit—which is not difficult or even particularly expensive for a great many hams-so it becomes a matter of operating skill and antenna efficiency if one is to break through to the rare one. For the antenna to be most

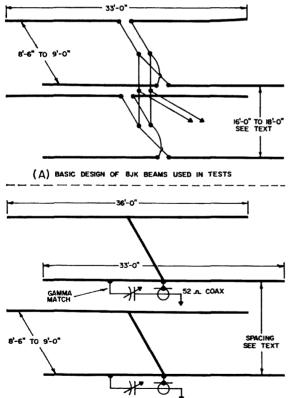


Fig. 1. The basic designs of the beam antennas used in the tests; in A is the 8JK array and in B, two 2-element beams.

(B) BASIC DESIGN OF TWO-ELEMENT BEAMS USED IN TESTS

useful for DX work, it should have as much gain as possible. It should also have as low an angle of radiation as possible. Of the two factors, the angle of radiation is probably most important. This will be especially noticeable when the band is just starting to open, and the antenna with a low angle will get through just a little before the competition. But, to achieve this low angle, careful consideration must be given to the type of antenna and its construction. Cost is also of importance of course.

It has been well established that a vertical antenna with a **good** ground radial system will achieve a low angle, and the ground plane is very popular as a result of this and of its low cost and simple construction. Half-wave and five-eighths wave verticals worked against ground are equally good and in many instances will not only hold their own against conventional yagis but will actually out-perform them.

The drawback of the vertical, from my point of view at least, is the omni-directional pattern, with no attenuation of unwanted signals from the sides or rear. There is also the lack of gain to consider. Although both signal discrimination and gain can be achieved by using several verticals and phasing them, few hams have the space to do this and usually look toward the yagi or cubical quad as being the best solution to the antenna situation.

There is a never-ending argument about the benefits of quad vs. yagi and the more one reads on the subject, the more he is inclined to believe that both antennas are excellent. It becomes more a matter of personal taste than anything else. However, there seems to be a fair amount of proof that the quad will perform better than the yagi for long DX if the antenna is not very high. If the antenna is mounted about one full wave above ground—approximately 70 feet in the case of 20 meters—there is apparently little to choose between yagi and

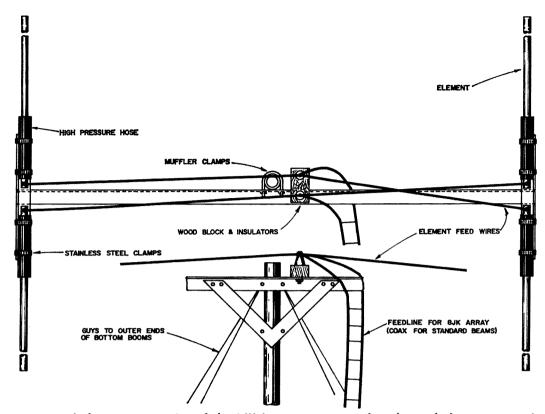


Fig. 2. Boom and element construction of the 8JK beam antennas used in the stacked-antenna experiments.

quad (assuming we are comparing antennas of the same general size, such as two-element quad and three element yagi).

Even at optimum antenna heights, the angle of radiation is not as low as may be desired and the most logical way to bring it down is to "stack" a second antenna over the first one, feeding the two in phase. Here we can probably relegate the quad to the sidelines, as the construction problems of stacking quads would be considerable to say the least. In the case of the vagi, however, it is quite possible to stack, and a number of amateurs do this with great success. Not only does this lower the radiation angle, but it also increases the overall gain of the system. Constructional problems are not too bad on 10 meters or even 15, but on 20 they can be rather formidable. Stacking also means using single-band beams, not too popular in this day of tribanders and multi-band operating.

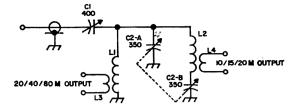
About two years ago, I had been operating in a temporary QTH with a ground plane and had the urge to put up something with some gain, reasonable directivity, low angle radiation, multi-band operation and low cost construction. The first effort along this line was a wire array, consisting of two 8JK

arrays stacked ¼ wave apart (at 20 meters) and driven through an antenna tuner. This proved to be a most effective antenna. Having the ground plane right beside it for comparison, it was quite easy to make alternative checks on a great many stations. For fairly short hops, such as from the East coast to Europe, there appeared to be little difference although the 8IK array seemed to get through a little earlier. Actual signal reports were not too much different, but on long haul paths to South Africa or Australia the array proved a definite superiority. This was evidenced more by the consistency of contacts rather than actual signal reports, the difference being only a matter of an S unit or two at the average DX location. Received signals were better on the array by about the same amount but a certain part of this was due to the front-to-side discrimination of the array. As with any 8JK, this array was bi-directional so front-to-back ratio was nil and of course there was no rotation system.

Results on 10 and 15 meters with the same array were not as clearly defined as on 20 because of the very poor band conditions at that time. However, the array did load very satisfactorily on 40 meters, and

proved to work extremely well. An inverted Vee was used for checking results, with it's apex fifty feet high, and the 8JK consistently provided QSOs with Europe and the Pacific which were not possible with the inverted Vee. The QTH at the time was on a hillside which overlooked the ocean and was extremely quiet, with no close neighbors or other sources of man-made noise. One rather strange feature of this array was its ability to put a good signal into West Africa which was off to the side somewhat and which could not be contacted at all using the inverted Vee.

The biggest drawback of this array was its size and the fact that two fairly sturdy masts were necessary to hold it up in the high winds which were a notable feature of this location. A transfer to another town meant the dismantling of the array and space at the new QTH limited new antenna efforts to a single tower. Along the way I had picked up a crank-up tower and this became the centre of the next projects. Having had such good success with the wire array, I proceeded to plan another one, but this time building it of metal in the form of two similar beams of 2-elements each. Because of the close spacing and the need for all elements to be insulated from the boom and tower, the construction was a little more difficult than for a normal plumber's delight type of beam. It was not, by any means, either expensive or requiring any special tools, and the final result was very neat and clean-cut in appearance. For those who may be interested in this array, some constructional hints are given in Fig. 2. Fig. 1 shows the basic diagram of the antenna and its feed line system. It is simply the standard 8JK array using two stacked sections. The obvious advantages of construction are the short booms required, and the comparatively small stacking distance. Although the open-wire feedline requires some careful planning, the advantage to be gained is multi-band operation. Looking at the photograph of the array, it will be seen that no rotator was used, simply because the tower was quite small in diameter and my operating hours permitted the use of only one or two possible paths-however, a rotator could be included and would not have to be elaborate. Since the array is bi-directional it only has to be turned half-way round the circle to cover all directions. This might be a good moment to point out that one



LI - II TURNS NO. 12, 2" O.D., 2 3/4" LG L2 - 5 1/2 TURNS NO. 12, 2" O.D., 1 1/4" LG L3 - 6 TURNS NO. 12, 2 1/2" O.D., 1 1/2" LG L4 - 5 TURNS NO. 12, 2 1/2" O.D., 1 1/4" LG

Fig. 3. The antenna tuner which was used to obtain 80, 40, 20, 15 and 10 meter operation from the stacked 8JK beams.

section could be built and the same advantages enjoyed, but the two sections produce somewhat more gain and what is more important, lowers the angle of radiation for DX work.

Fig. 2 shows the general construction of the boom assembly, which is made from 2" or 2½" angle iron or aluminum, with similar pieces of angle either bolted or welded to the ends to act as element supports. The old standby-muffler clamps were used to clamp the boom in place, and of course liberally coated with zinc chromate and aluminum paint to preserve them from the salt air. The elements were made from 65ST6 aluminum tubing with an .035 wall. Diameters of 1 inch and % inch allowed the usual telescoping method of construction. The necessity for insulating the elements can be solved by the use of insulators, but I visited the maintenance shop of a local fish processing plant and obtained some lengths of high pressure steam hose. This has various diameters, depending upon the pressure it is designed for, but even the lowest pressure stuff will have a wall thick enough for adequate insulation. It is, of course, unaffected by water and I selected pieces which had a 1" inside diameter. By dusting the inside of the hose with talcum powder, the tubing will slide into the hose fairly easily. Allow an inch or so of the tubing to protrude from the far end of the hose for the feedline to attach. The whole affair is held to the boom by simply laying the hose and element in the "trough' of the angle iron and using two stainless steel hose clamps around both the iron and the element. The actual length of the elements can be from about 33 to 40 feet with no ill effects, but they must all be the same length. Fig. 2 also shows the method of mounting the feedline.

A small wooden block is mounted on the boom, and two insulators of different height are mounted on the block. By using the difference in height, the wires of the element feeder will not touch each other as they transpose. It is also a good idea to use insulated wires for this part of the feed system, and make sure the feeders between the elements are actually transposed or the system will not feed properly.

Both booms are identical, and are mounted on the mast about 16 feet apart. By making a simple stand-off insulator of wood dipped in paraffin and clamped to the mast, the feedline is held off from the mast and the insulator also forms a convenient point at which to attach the feeder from the transmitter. The feeder is easily made from any wire from size 10 to 14 or thereabouts. spaced by wooden dowel cut into short pieces. If the transmitter is medium power the feeder can be made from TV ladder line. If the line enters the house low enough to be reached by children, it should be enclosed in a protective cover. I found a very simple method was to use two lengths of plastic water pipe, which is very tough and rigid as well as being a good insulator. An antenna tuner is of course a "must" for this array. The all band tuner in Fig. 3 is the one I have used on this array in both the wire and all-metal configurations. It has the advantage of being continuously tuneable across all bands from 80 to 10 meters. As usual, an SWR bridge is almost a necessity for the initial tune-up and a pair of calibrated dials should be used on the tuning capacitors. Once the proper settings are found, a simple chart should be made to allow rapid OSY and band change.

During the time this antenna was under construction the trusty ground plane had already been installed for 20 meters, and a second one constructed for 15. There was also the 40-meter inverted Vee again up on a separate pole. No attempt was made to run checks on 10 as the band was almost completely dead all the time I was at that QTH. Daily QSOs on 20 were providing good information on general conditions, but when the array was first tried one evening with a friend in VE4 land, his comment was that the beam "wasn't doing a thing for me"-quite frustrating to say the least! Next morning a contact in England came out the same way, neither better nor worse than the ground plane. Throughout most of

Europe the fesults were the same and disappointment was growing by the minute. Operations had to cease to go to work, and for the next several mornings the same results were obtained and the array very nearly was torn down. Finally however after running a check with a DL station I was called by a UAØ and his report gave the array an edge of two S units over the ground plane. Subsequent OSOs over the next few weeks proved that the array was behaving very much the same as the wire one had in good but not spectacular reports from Europe or across North America, but gradually better results from longer distances. Rather than glowing reports, the best thing that came of all this was the noticeably higher ratio of calls answered to calls made, particularly with long-path calls to the Pacific. The directivity pattern appeared to be a very broad figure 8 with quite good attenuation off the sides.

Results on 15 meters were somewhat different. The long-haul capabilities were as good as on 20, but signal reports from Europe and the West Coast were quite a bit better than with the ground plane, often being 3 or 4 S-units higher. The spacing of the beams was wider of course on this band (as related to wavelength) and after some misgivings the array was taken down and an extension mast installed so that the top beam could be about 28 feet above the bottom one. It would have probably been better to use a full wave separation of about 32 feet but this could not be managed with this light duty tower. However, the increased spacing improved results considerably. European stations now reported a noticeable gain in signal strength on 20 and a couple of S-units higher on 15. On longhaul contacts the difference was not too much, and results were about the same as with the closer spacing. This seemed to indicate that the spacing of the beams had considerably more effect on the gain than on the angle of radiation. Although I made careful note of the signal reports given by stations overseas. I would be careful about making any claims for unusual gain from the array. Unless one is equipped, and qualified, to make proper instrumented gain measurements on an antenna I feel it is better to simply claim no definite figures but merely give the results in general terms.

After using the array for about four months, it was again taken down, and the

8IK beams converted to normal 2-element 20-meter beams with all-metal construction. This was simply done by removing the insulating hose from the elements, coupling them together at their center and fastening them directly to their supports with plated machine bolts. The boom length of 8 feet was comparable to element spacing in some commercial beams. The stacking distance was again limited to 28 feet maximum, and each beam operated as a driven element and reflector combination. Gamma matches were used with RG-8/U 52-ohm coax and a separate feedline used on each beam and taken down to the operating position. With a small coax switch, the rig could be switched between either beam or the ground plane. Of course, the elements had been adjusted to the normal length for a 20 meter beam, and the multi-band feature had been

Results now were somewhat different, but more in line with past experience when going from a dipole or ground plane to a beam. Results in Europe were normal, with either beam giving a better report than the ground plane, but not noticeably different from one beam or the other. As the skip lengthened, the comparative signal strength difference lessened gradually until it was not of any real importance. The beams still probably gave slightly better results but the ground plane was holding its own very



"I see your ol' man is lousing up the air waves again!"

well, and in VK/ZL land there was apparently very little to choose between the antennas. I might mention I adopted a practice of switching back and forth between the three antennas, either on alternate transmissions or between words on a single transmission. Sometimes I would tell the other station what I was doing and sometimes not, the idea being to try to average out reports from stations who knew what was going on along with those who didn't.

After a couple of months of this sort of thing, I made up a couple of pieces of RG-8/U cable about one electrical wavelength long (approximately % wavelength physically) and used one piece to feed each beam. Then using a T connector I fed both beams from a single feedline. In other words, taking Fig. 4 as a reference, substitute the open wire line with coax. I still used the gamma matches on the beams and there was quite an interesting time getting both matches adjusted quite right. Whether it was worth worrying too much about is problematical and I rather think results would have been just as good if I had merely connected the coax directly to the center of the driven elements. However, this would have meant opening the element again and insulating it from the boom and this was too much of a chore. The eventual SWR reading on the bridge was about 1.8:1 which was considered good enough.

Operation was now found to be considerably improved. Stacking the beams is supposed to give a 3 dB gain both on sending and receiving and it did appear that this was happening or at least a good part of it. Again, only the ground plane was used for reference since several days usually elapsed between tests, but there was considerable increase in received signal strength. Reports received from the other end were also quite complimentary. European and North American contacts were not made at the same time because of the good front-toback ratio of the beams and the necessity of turning them by hand power. Eventually a rotator was constructed from a prop pitch motor and the small light-weight tower was rotated as a whole unit, with a bearing ring fabricated and installed to allow the guy wires to remain stationary. This was a major project in itself and, when completed, it allowed much more facility in tests. The morning path to the Pacific gave some very pleasing results with the two beams fed

together and this finally appeared to be the best configuration. Stations called on the ground plane could usually be contacted, though at times with some difficulty. Switching to the beams part way through the QSO generally brought comments such as "the band is improving" or "the skip is changing," etc., accompanied by a better signal report. I feel it is very difficult to attribute this merely to the extra gain of the array or the different angle of radiation. It seems definite that both factors would enter into the picture, though which would be dominant is hard to say. Several times were noted in which stations could be heard on the beams and contacted but which could not be worked on the ground plane; this would seem to point to a lower angle rather than just the gain feature.

The logical extension to these tests would be to increase the beam stacking distance to a full wavelength and/or add a third element (director) to each beam. Both ideas would have required a considerably heavier tower than I had available. It is also a very expensive undertaking. However, the experience of amateurs who are already using such arrays should be sufficient evidence of their value. The arrays tried at my QTH were all made in the basement, of common materials and using simple tools. They are well within the ability and pocketbook of the average ham.

To recapitulate then, the stacked 8JK array should be very satisfactory if one requires a good DX antenna with multi-band capabilities, but whose bi-directional characteristics mean no front-to-back ratio at all. It has the advantage of giving good coverage over two most used signal paths (providing they are in opposite directions) without a rotator, but the construction of the feedline and elements is more complicated. A tuner is also required. The stacked 2element beams give the best overall results but should have stacking distance as close as possible to a wavelength for best operation, and a rotator will be necessary for best operation. On 20 meters this presents formidable construction problems, but on 10 meters it would be much simpler. The tests were brought to a halt in my case by another transfer-probably to the neighbors' immense relief-and the story is presented for the benefit of any who might be thinking along similar lines. . . . VE1TG

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A Simple Antenna Mount for Satellite Work

This elevation-azimuth mount is a rather straightforward approach to satellite tracking and moonbounce work. Many of the construction principles used by W4HJZ are equally applicable to polar mounts.

Over the past few years the author has constructed numerous temporary antenna setups for moonbounce via KP4BPZ and for the Oscar series of satellites. All arrays were hand operated and of the azimuth-elevation type. When the time came to construct Oscar IV antennas, it was decided that too much time was being wasted on these temporary mounts and a more permanent rotor driven system was in order.

The polar mount is best for tracking the moon because the elevation angle above the southern horizon is constant for a given pass of the moon, and only one direction of rotation is necessary to follow the moon across the sky. The azimuth-elevation mount is more flexible and can aim an array in any direction. Its disadvantage is that two rotor controls must be simultaneously manipulated to follow an object across the sky. The advantages of both mounts can be had in an elevation-azimuth system. With the EL-AZ mount, by aiming the array south and elevating it to the proper angle above the southern horizon, the azimuth rotor becomes the "hour angle" and the elevation rotor need not be touched for an entire pass of the moon, or any other equatorial orbit satellite. By aiming the array east to west and fixing it in place, the elevation rotor aims the array at the desired angle above the eastern or western horizons and the azimuth rotor makes the array follow a polar orbiting satellite.

To set up the array for polar or equatorial orbits, the mast must be rotated 90° and this done by hand. At the base of the mast the U-bolts are loosened, the mast rotated, and then the U-bolts tightened.

For elevation and azimuth controls Cornell-Dubilier TR-44 rotors were chosen for their good torque and indicator accuracy. However, these rotators have a brake mechansim that works via gravity on the motor shaft. When employed in a horizontal position, the brakes do not operate properly. The rotors must be modified. A small spring must be installed which will press against the end of the motor shaft and hold the brake clutch engaged, center the armature in the field, and release the brake clutch. The spring is fashioned from flat spring copper about % x 1 inches and can be held in place under an existing screw which holds the indicator pot to the end of the motor. Spring tension should be adjusted for best clutch pressure consistent with good motor starting and armature pull-in.

Notes on the mechanics

The mast is approximately 2" diameter and 10 feet high. It turns freely in a slightly larger piece of pipe which is imbedded in concrete. Guy wires attach via a slip ring at a point just below the rotor box.

The rotor box is fabricated from % inch aluminum (old rack panels) using % inch diameter bolts. Its bottom is approximately

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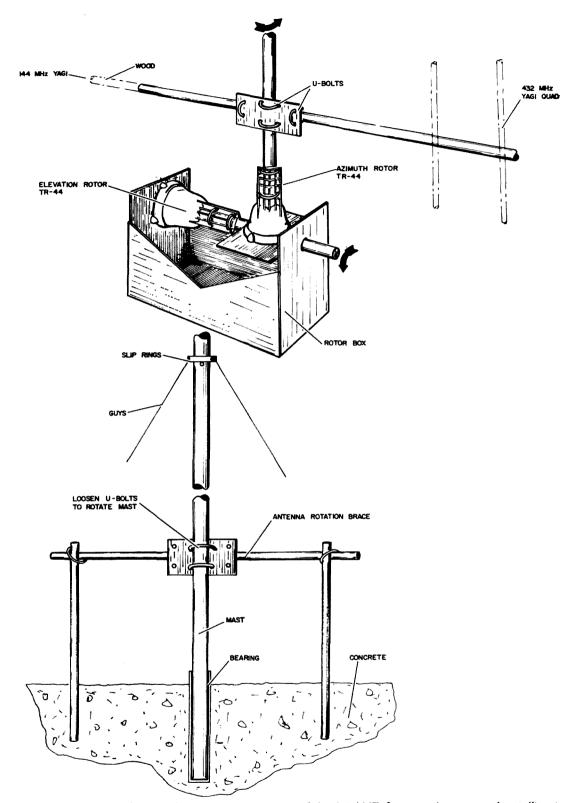


Fig. 1. Construction of the simple antenna mount used by W4HJZ for moonbounce and satellite tracking.

12 x 24. The end plates are approximately 12 x 12. A four inch skirt extends below the bottom for torsional strength. All corners are held firm with angle brackets. The

rotor box mounts to the mast with the rotor to mast adapter plate which is supplied as part of the TR44 rotors.

. . . W4HJZ

Strong-Signal Interference

If you live in an area where there is a multitude of hams, and there is practically a kilowatt in your backyard, these receiver modifications suggested by K6KA may be helpful in eliminating strong-signal interference.

These are the days of widespread purchase of expensive amateur radio equipment. One wonders whether the receivers were designed in a screen-room, or out on some isolated island with no DXpedition present. In the homes of amateurs, they experience a very different environment. Don Wallace, W6AM, estimates that there are 10,000 amateurs within ground-wave distance of his Palos Verdes hilltop station. Thousands are lineof-sight. This means not only that there is usually a strong station almost in every block, but also that several hundred kilocycles in and out of a band pass through the first if of the receiver. This may represent megawatts of transmitter power which reaches the second mixer grid after too little attenuation.

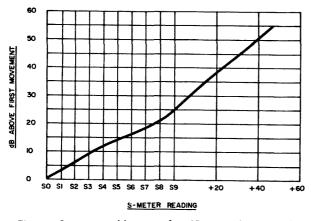


Fig. 1. S-meter calibration for SB-300. The unmodified curve is satisfactory. Without agc on the rf tube, the curve is too flat. Adding the parallel 100-ohm resistor produces a good calibration, even between the 20-db points above S-9. The bend in the curves around S-9 is due principally to the scale markings; a flatter curve can be produced by using wider spacing on the graph.

No longer can we operate as the Navy did 25 years ago using Model RBC receivers. There were several kilowatt transmitters going in the same ship, without mutual interference between circuits. Things have improved. Under similar conditions now, we cannot operate at all.

One receiver—not made in this country—gives excellent promise of operating in a crowded neighborhood without modification both here and at W6YY. An inquiry to an independent source has brought this response: "Any decent receiver, of course, should have a tuned front end if it is going to reject some of the crud, but no front end is going to stand up to a kilowatt in your back yard." Ah, but not all is lost!

Heathkit SB-300

Upon getting back into active amateur radio, my first experience was with the Heath-kit SB-300. Occasionally, the S-meter would hit the pin, and nothing would come out of the audio. As stated by Stuart Meyer, W2GHK, in a paper delivered to IARC, "Very often, these strong off-channel signals will completely block the receiver, and the operator is not able to identify the offender!"

With the help of the one piece of equipment needed to check out the SB-line, the vacuum-tube voltmeter found that the *if* tube grids were being driven negative by almost 50 volts, even with the agc switch off. This turned out to be a problem frequently experienced by amateurs using various types of equipment, although not always to the same extent. A local amateur's radiation put several volts on the grid of the rf tube. This

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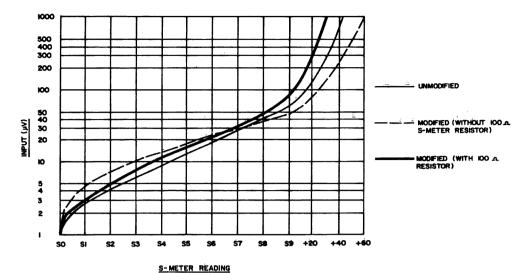


Fig 2. S-meter calibration for modified Collins 75S-3A, with the 100-ohm resistor in parallel with the meter. The slight bend in the surve at S-8 appears to be typical. Each 20 dB segment of the meter actually requires from 13 to 15 dB increase in receiver input, thus making antennas and linear amplifiers look somewhat better than they are.

was rectified. It charged up the grid capacitor, which could discharge only by leaking down the agc buss to the *if* tube grids. Someone suggested putting an attenuator in the antenna lead—which worked just about as well as using the on-off switch.

Once the cause was isolated, the yellow agc buss to the rf circuit board was disconnected and taped up. The grid capacitor was shorted. No longer was there reaction on the *if* stages nor on the S-meter. The only remaining interference was a buck-shot background that did not completely disrupt operation on the opposite end of the band. This is the type of "modification" that I like—one that can be restored in a few moments, leaving no trace.

Modified performance

Such changes are not without their effects. Obviously, the total age action would be reduced. Measurements indicated that a one-dB change in audio on an output meter resulted from each five-dB change in signal from an rf signal generator. This represented some reduction in age action from the unmodified condition, but it was not noticeable on CW and single-sideband signals. It was not considered to be a disadvantage.

Another change was in the activity of the S-meter. It was necessary to put a 100-ohm resistor directly across the S-meter terminals. The result was slightly better than the original S-meter performance, as shown in Fig. 1.

The receiver sensitivity (signal-plus-noise-

to-noise) ratio did not deteriorate. It was just slightly better with the modification.

Collins S-Line

A similar change was made in Collins S-Line receivers, with equally effective results. The voice quality might have deteriorated slightly on very loud signals, but this presented no problem. The same S-meter shunt was required. The if gain was set at a middle position where loud CW signals in zero beat did not tend to block the bfo operation slightly when listening through zero beat to weak signals. The final S-meter calibration is given in Fig. 2. S-zero was taken as "first movement" which was at 1.3 μ V. The input for S-9 was 24 μ V.

The rf tube in the 75S-line obtains its bias from the agc line. There is no cathode bias. Therefore, this modification requires a cathode resistor, carefully by-passed with a good high-frequency ceramic or mica capacitor with very short leads to cathode and ground. The small 0.001 µF Sprague was fine. The resistor value is 180 ohms for the 6DC6 tube, which requires its bias between pin 2 and ground. If the 6FV6 is used for more gain, the cathode resistor can be about 140 ohms, but it goes between pin 7 and ground.

With a poor by-pass, the 6FV6 will be regenerative on 28 MHz without the antenna connected to the receiver. Shorting the grid capacitor can be avoided by using a choke from grid to ground, both of which are more

accessible than the coil end of the grid capacitor.

Swan 350

The circuit for the Swan 350 was studied. In this transceiver, it would appear to be better to disconnect the agc buss and to substitute an rf choke from grid to ground on the rf stage, because of the need for a direct-current blocking capacitor between the transmitter and the grid of the rf tube. The change probably will be made in one of the Swan transceivers that operate a hundred yards from my location.

Results

The proposals made above have proven

helpful to a number of local amateurs. Refinements may be made in the future, particularly by using a grid-to-ground rf choke, terminating in a low-resistance cathode potentiometer that will increase the bias on the rf tube. This is desirable under strong-signal conditions in which the signal-plus-noise-to-noise ratio is adequate. In the meantime, detuning the preselection away from an interfering signal is possible. Also, an rf attenuator such as the Waters 37I can be inserted in the antenna lead.

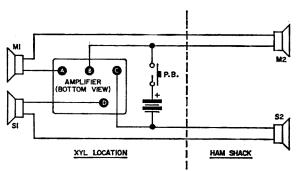
Other potential solutions to the problems of strong-signal interference, spurious responses, cross-modulation and intermodulation distortion, will be presented in an early issue.

K6KA

A Molded-Mud Intercom



By this time, everybody has seen the assortment of epoxy transistor modules for phono amplifiers, PA amplifiers, intercoms, etc., which are advertised in many of the current catalogs and are available at your local parts dealer. For certain uses they aren't bad. You can build a lo-fi phone amplifier out of them for the kids°, or put together an intercom between the kitchen and



MI, M2 = MICROPHONE (SMALL SPEAKER) SI, S2 = SPEAKER

the ham shack is just about nothing flat. We have done both.

All is not gold that glitters, however. It seems that in addition to the "molded mud module" you need a couple of speakers, a volume control with switch, and a four-pole double-throw switch. Most hams have cannibalized a few TV sets, and the neighbors have given them a radio that junior dropped on the basement floor, so there are usually several speakers in the junk box. Even a volume control with a switch might be expected. But four-pole double-throw switches are not exactly a stock item. Nor are they cheap.

Well, I went down to the local electronics emporium and invested \$3.50 in the molded-mud module because my wife got tired of hollering up the stairs when chow was on, or when a call came in on the telephone, or for some other reason. We experimented around to see what the thing would do, and came up with the following:

Not having a four-pole double-throw switch, and not feeling in need of a volume control, and having a drawer full of small speakers, I decided to have all circuits hot at all times. As the circuit indicates, both listening speakers and "mike" speakers are on whenever the switch is on. Strangely enough, there is no feed back and it is just like talking on the telephone.

... Bob Baird W7CSD

*Using 40 ohm 6" x 8" speakers and 2 modules you get reasonable quality stereo.

Charging Dry Batteries

A secondary cell is defined as a cell which can be recharged while a primary cell can not. An ordinary dry cell is a primary cell, right? On the other hand, you can buy clever little devices which are claimed to be able to recharge dry cells. Who is kidding who. Or whom?

It is possible, under proper conditions, to recharge dry cells. If you are a steady and frequent user of them, it may even be economical. But, if you buy two cells for a flashlight once a year and they go shelf dead, forget it.

Scientific information on the subject is hard to find, but there is a little (References 1, 2, 3, 4). This lack of information does not represent a conspiracy on the part of the manufacturers to sell more batteries; as we will see, recharging is apt to be more trouble than it is worth to the occasional user.

I first learned about the recharging bit in World War II, from a British magazine which I have long since lost. At the airbase where I was stationed, we used flashlight batteries by the hundred while servicing planes at night. That usage happened to be ideal for recharging, and we had dozens of cells on charge every night. Nowadays, with toys and transistor gadgets using up scads of batteries, I have revived the scheme.

The recharging procedure is quite simple; you pass a reverse current back into the cell to replace what has been taken out. Since carbon-zinc cells, like any other type, are not 100% efficient, more must be put in than comes back out again.

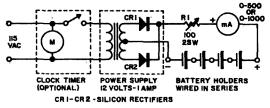


Fig. 1. Typical dry cell charging circuit. See text for discussion of circuit values.

The charging circuit

Any low voltage de supply can be made to do; it must have more voltage available than that of the largest number of cells you expect to charge in series. A quarter or half an ampere is enough current for most uses. I use an HO-model railroad supply delivering 12 volts at 1 ampere, so I can charge up to 7 of the 1.5 volt cells in series. A variable resistor, a milliammeter and a string of cell holders are connected in series with the supply; Fig. 1 shows the arrangement. The clock timer on the primary side, I find, is very useful as I am the forgetful type. It allows me to set up a predetermined amount of charge to a string of cells, and to take them out some time later. For the same reason, the rectifiers in the dc supply should have low reverse leakage so that the charged cells will not discharge back through the supply when it shuts off. Measure your rectifiers with a good high-range ohmmeter and, if they show measurable reverse leakage, replace them with good low leakage silicon ones of sufficient current rating.

The variable resistor R1 adjusts the charging current to the desired value; it must be able to carry the maximum current you will use, and have enough resistance to hold the current down for the smallest cell you will charge. I put a 25-watt 100 ohm rheostat in my supply, which will carry 500 milliamps easily, but I have to add extra resistance in series when charging the smallest cells.

500 milliamps or 1 ampere is a convenient range for the meter. I used an 800 mA meter because it was on hand. If you want an extra visual indicator, connect a flashlight bulb in series also. It will serve as a fuse, too. Pick one with plenty of current rating, as they don't last too long at full current.

Mount all the above on a board or chassis, with enough battery holders to accommodate all the cells you want to charge at one time, and all the sizes. My board will hold 7 of

the D (large flashlight) size, or 7 of the C (small flashlight) or 7 of the AA size (standard penlite), or 3 of the AAA (thin penlite) cells. A clip lead selects which bank of holders is used, and jumpers across the unused holders when less than a full load of cells is being charged.

Suitable holders are made by Keystone, their number 175 (D size), number 173 (C size), or number 139 (AA size), and by several other manufacturers. Multiple cell holders are also available. If you are handy with spring brass, you could make your own. Being a bit fumble-fingered, after trying a couple, I decided the "boughten" ones were a bargain. (They vanish off the market at Christmas time, so get them early).

How to use the charger

We now have a suitable charging circuit, but it must be properly used. Follow these rules carefully:

We now have a suitable charging circuit, but it must be properly used. Follow these rules carefully:

- 1 New, quality cells, on moderate drain and used up fairly quickly, say within a couple of weeks, will charge up best. Cells used very slowly or "shelf dead" will not charge well, due to loss of internal moisture.
- 2 For good results, remove the cells from service before they are completely dead. One volt under load is a good end point.
- 3 Determine the condition of the cells from Table 1 (the tester shown in Fig. 2 is convenient) and put them on charge right away. A dead cell deteriorates fairly rapidly.
- 4 Any bulged, leaking or corroded cells should be thrown out immediately.
- 5 Charge according to **Table 2.** From the condition of the cells found in step 3, pick the proper column in **Table 2.** Find the number of milliampere hours for the

Table 1. Condition of cells using tester of Fig. 2.

Voltage	Charge Condition	
1.5	New	
1.4	Full	
1.3	3/4	
1.2	Half	
1.1	1/4	
1.0	Dead	

Note: While carbon-zinc cells can be discharged below 1.0 volt, it is not recommended if the cells are to be recharged.

size of cell being charged. The product of charging rate in milliamperes times charging time in hours is the charge in milliampere-hours. Do not exceed the maximum charging rate called for by **Table 2**, but there is no harm in charging at a lower rate for a longer time.

6- After charging, stabilize the cells by waiting 6 hours before testing them for condition or putting them into service. Just after charging, the voltage of the cells may be abnormally high and might cause damage to equipment.

7 - Do not overcharge, as this quickly ruins the cell. When in doubt, it is better to give less than the recommended charge, stabilize, test again for condition and give the remaining charge as called for by the cell condition and **Table 2**. Stop when the cell reads 1.4 to 1.5 volts after stabilizing; do not push the charge to the point where cell voltage begins to go down again.

8 - Put the recharged cells back in service soon, as their shelf life is not too good. Avoid charging up a large batch and letting them sit around; it is better to use a few cells over and over until they will no longer take a charge.

9-An average of four charge-discharge cycles can be expected from good quality cells treated as above. Large cells tend to

Table 2. Charging data for standard carbon-zinc dry cells.

Cell	Cell	Rated	Maximum	Rec	ommended m	A/Hr. Charge	***
Size	Diam. Inches	Capacity mA/Hour*	Charge Rate, mA	Dead	1/4	Half	3/4
D	1-5/16	4250	400	5000	3750	2500	1250
С	i	2150	200	2600	1950	1300	650
AA	1/2	750	75	900	675	450	225
AAA	3/8	410	40	490	367	245	122
N	7/Ĭ6	460	40	550	412	275	137
Tran.	**	410	40	490	367	245	122

* Service life when discharged to 1.0 volt in 50 hours at 4 hours per day. (Data taken from reference 5)

** 9 volt transistor battery, I inch wide by 0.6 inch thick.

*** Approximate, see text.

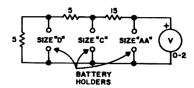


Fig. 2. Tester for dry cells. This tester puts a load on a standard carbon-zinc cell approximately equal to its 10-hour intermittent discharge rated load. A 40-ohm load should be used when testing AAA or N size cells. A 9-volt transistor battery should be tested with a 250-ohm load and will give six times the voltage listed in Table 1.

recharge better than small ones.

Other hints

Especially when charging a full stack of cells, so that there is very little voltage drop across R1, recheck the charging rate after the first hour or so. The voltage of the cells may change quite a bit in the first few minutes, so that the charging rate may need readjustment.

If no charging current at all can be obtained, you may have poor contact at a battery holder, or a completely open cell, which happens once in a while. Take a voltmeter and go looking for the cell holder with too much voltage across it. (Or, you may be trying to charge too many cells for the available charging voltage.)

Dry cells will not charge well in parallel, since they will usually not divide the current properly between them. If you must charge more than one string of cells at a time, use a separate R1 for each string. The milliammeter could be connected in series with each string in turn, by a plug and closed-circuit jacks or a suitable switch.

The amount of milliampere-hours charging time given in Table 2 is an educated guess, as the milliampere-hour capacity of cells varies somewhat with the make, the age and previous condition of servitude. Also, as a browse through references 4 and 5 will show, cells of the same size are made for several different uses such as transistor de-

vices, flashlight, heavy duty, photoflash, etc., and their capacities are not all the same. The capacity given in Table 2 is that of a standard flashlight cell discharged to 1.0 volt end point in 50 hours at 4 hours a day, and the charging milliampere hours given are 120% of that capacity. These figures will do as a general guide; when in doubt charge up in steps as described in step 7 above. Where possible, stick with one make and type of cell and keep records on it until you find out its charging requirements. The maximum charging rate given in the table is 10 percent of the cell capacity; this should be quite safe.

Charging other types of cells

Do not attempt to recharge mercury cells. Their large capacity and rather high cost may make this a tempting idea, but the manufacturers warn that it may cause the cells to explode (I have not verified this from personal experience). A couple of years ago there were some rumors of a rechargeable mercury cell being developed, but nothing seems to have come of it.

Heavy duty carbon-zinc cells may have up to 50 percent more capacity than listed in Table 2, and take correspondingly more charge.

Alkaline cells have about twice the capacity of standard carbon-zinc cells (see Table 3). One manufacturer recommends that they not be recharged. On the basis of limited experience I find that they seem to charge up and hold a charge better then carbon-zinc types; I have had a set of four recharged penlite cells in a little transistor tester for over a year. As a first guess, you might try charging to 120 percent of the capacity given in Table 3, for fully discharged alkaline cells (to 1 volt end point).

A rechargeable type of alkaline cell is now being made; I have no experience with it. If you should run across any, follow the manufacturer's recommended recharging procedure.

Table 3. Capacity of alkaline cells

Cell Size	Rated Capacity MaHour*	Maximum Charge Rate, Ma.	Approximate** Charge for a Dead Cell. Ma. Hr.
D	8500	850	10200
С	3500	350	4200
AA	1400	140	1680
AAA	750	75	900
N	600	60	720

* Estimated service life to 1.0 volt (from ref. 5)

^{**} Very approximate due to limited experience

Nickel-cadmium and other secondary cells may, of course, be charged by the circuit of Fig. 1. The condition of most true secondary cells (possibly excepting the alkaline cells just mentioned) cannot be determined by a tester such as that of Fig. 2, since the cell voltage does not drop steadily with use. Again, the manufacturer's recommended charging time and rate should be used.

Constant voltage charging

The charging method described so far is a constant current method, where the current charges very little over the whole time, A constant voltage method is often recommended for secondary cells and claimed to give superior performance. It is possible that such a method would work well with dry cells also; here is a good field for investigation for someone who has the time and curiosity. Briefly, the charging voltage is adjusted to be exactly equal to the voltage of the fully charged cell, and only a small series resistor is used. Thus the charging current is high at first, when the cell can stand it, and falls to a low trickle charge at the end. The charging time becomes non-critical.

Summary

As you can see, recharging of ordinary dry cells is quite possible, but not especially simple. If you use fairly large quantities of them, you may find it worth the trouble. If this is so, you also may be close to the point where nickel-cadmium or other secondary cells will work out better because of the large number of times they can be recharged, and this should be considered. There remains a range of applications where dry cell charging is worth while, and you may want to try it anyway just to find out how it works.

. . . WA6NIL

References

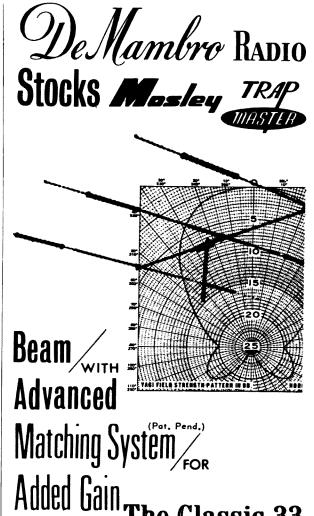
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A Forty Meter Vertical Array

With the increase in foreign broadcast activity in the forty-meter band, night-time operation has become difficult, if not impossible, in the eastern part of the country. The installation of a parasitic beam is one solution but it is expensive and presents many structural and support problems and was ruled out for this location. The three-element vertical all-driven array was the final result of several months experimentation.

In the time it has been in use, it has been found to consistently outperform the extended double-zepp 90 feet in the air used as a reference antenna. Although no means of measuring the gain was available, a figure of 5 to 8 dB would seem reasonable.

The front-to-back ratio is comparable to, or perhaps slightly better than, that of the three-element parasitic beam, apparently running from 15 to 40 dB on skywaye and well in excess of 60 dB on ground-wave signals.

When erected on a northeast-southwest line, the unidirectional pattern is excellent for DX work into both Europe and the South Pacific areas. When working west, a substantial decrease in broadcast interference will be noted.

The array consists of three driven onequarter wave elements phased progressively in 90-degree steps, resulting in a unidirectional pattern in the direction of the lagging elements.

In a three-element array of this type, it is necessary to employ binomial current distribution to obtain the best front-to-back ratio. In effect, half the current in the end elements as in the center one. This is accomplished by coil L2. The inductance of this coil is not particularly critical but the reactance should be enough higher than the impedance of the elements to prevent serious power losses. Excessive reactance is tuned out by the C1-L1 combination after final tuning of the array.

The pattern is reversed by a DPDT relay which is controlled from inside the shack. A second control switch is installed at the divider box for ease of tune up, but it may be removed after initial tune up.

Phasing is accomplished by means of proper length feedlines and a 180-degree coax phasing line which is switched into

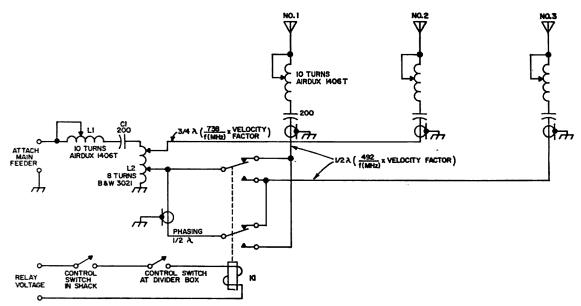


Fig. 1. Diagram of the 40-meter vertical array. The spacing between elements is 34 feet, 3 inches. The $\frac{1}{2}$ -wave phasing line using RG-8/U coax is 45 feet long (54 feet, 7 inches for foam coax). The $\frac{3}{4}$ wave phasing line is 67 feet, 6 inches long (81 feet, 9 inches for foam).

30

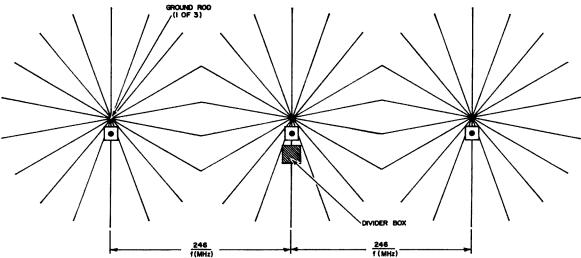


Fig. 2. Physical layout of the three-element vertical 40-meter array.

the feedline of either element one or three. Element two is always 90 degrees out of phase with the other two elements. No switching is done in this line.

Element construction

The elements are constructed from 3-inch round galvanized downspout available for about \$1.25 a length. Three ten-foot lengths are driven together and the joints secured with sheet metal screws. Each joint should then be soldered using a torch and acid solder. At a point 22 feet from one end, drill pairs of 4-inch holes at 120-degree intervals and attach three one-foot lengths of guy wire. Place a strain insulator on the free end of each and attach the regular guy wires.

Base platforms

The base platforms are 2½-feet high with a square top of three-quarter inch plywood 18 inches square. The corner posts are 2x2 lumber which is braced with 1x2 furring strips. After painting the bottom, 6 inches is coated with roof coating and set in the ground. A smaller square of plywood is cut and a round hole is cut in it the size of the base of the quart pop bottle used as an insulator. These squares are nailed to the center of the platform top. Without the ring, the bottle has a tendency to kick out from under the element in high winds. In areas where deep snow is not a problem, the antenna bases may be installed at ground level.

Three-foot lengths of pipe should be driven into the ground at 120-degree in-

tervals around the base and about ten feet out to serve as guy anchors. When attaching the guys, a second strain insulator should be installed in each guy about two feet above the ground. The elements may be walked up by two people and lifted into place atop the insulator. One person can hold the element while the guy wires are tied down.

Ground System

The array was originally used with only a driven ground rod at the base of each element and performed quite well. However, a ground system of 20 radials was installed around each element and a worthwhile improvement was noted. The wire was laid on top of the ground. The radials should be tied together at all points where they intersect and also tied to the guy anchors. If only the rods are used, they should be tied together with heavy copper wire.

Base tuning networks

The tuning network at the base of each element consists of a 10-turn length of Airdux miniductor 1406T in series with a 200 pF mica transmitting capacitor. Since the elements are slightly short, this system permits tuning the element to any desired frequency in the band while keeping the self impedance close to 50 ohms. This avoids the necessity of raising and lowering the elements to trim them to the exact physical length.

Power divider and phasing

The power divider may be constructed

in a wood or metal box of any convenient size. If wood is used, a sheet of copper or aluminum should be attached to the bottom for grounding purposes. This should in turn be tied into the ground system.

An electrical half wavelength of 50-ohm coax should be brought from the elements to the divider box which is mounted at the base of the center element. A similiar length of feedline is brought from number 3. Both these lines attach to the switching relay as shown in the diagram. These lines should be cut according to length (ft) = (492/f) x velocity factor. At the same time, cut a third half-wave line to be used for the 180° phasing line.

Run a line % wavelength long (electrically) from element number 2 to the tuning box and connect it to the top of the divider coil as shown. Excess line may be coiled up and hung on the base platform. The phasing line should also be coiled out of the way and a copper clip installed on the input end to allow for moving the divider tap on the lines.

All shields should be grounded at both ends. RG-58/U is suitable for all element feedlines and the phasing line, however, if high power is used, the main feedline should be RG-8/U.



Seems he's repairing his antenna a lot these days!

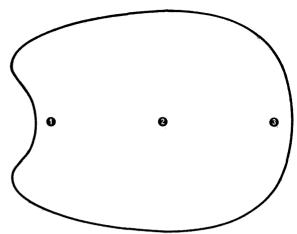


Fig. 3. Pattern of the array with 25% of the power at element 1 (0°); 50% of the power at element 2 at -90°; and 25% of the power at element 3 at -180°.

Element matching

All feedlines should be disconnected from the elements and the main feeder temporarily attached to one element. The element should be tuned for lowest SWR with an SWR bridge or a complete null with an impedance bridge. The process is repeated for each element.

This is a compromise match, as the impedance changes somewhat with all elements driven and each time direction is changed. As long as feedlines are multiples of ¼ wavelength, the reactance introduced is not sufficient to cause serious distortion of the pattern. Do not use lines of lengths other than those given unless they are multiples of ¼ wavelength.

The array was originally built with equal length feedlines of random length, however, the null was shifted 30° to one side. When the element 1 and 3 lines were increased to ½ wave and element 2 line to ¾ wave, the null moved to the rear where it should be.

Additional relays were then installed at each element to change matching coil taps when the direction was switched. However, they did not result in any noticeable improvement and have since been removed.

Power divider adjustment

To tune the divider, all feedlines should be attached to the elements and the feeder taps connected at the top of the divider coil. A small amount of power is applied to the array and L1-C1 adjusted for lowest SWR by moving the shorting clip. If an impedance bridge is used, the measured impedance will be quite low.

Adjustment for the best front-to-back ratio

is accomplished by tapping the clip for elements 1 and 3 down the coil until the best front-to-back is observed on received signals or by checking with a field-strength meter. A tap about two turns from the top of the coil is a good starting point.

A much more accurate adjustment may be made if a mobile rig is available. A switch is installed at the power divider for direction change and a remote S-meter brought out from the receiver in the shack. If the receiver has an S-meter circuit which does not allow the meter to work at less than full rf gain, a T-pad will be needed to reduce the reading to around S-9 with the antenna toward the signal source. The array is then switched away from the mobile rig which should be at least ¼ mile away and in line with the array. With careful adjustment of the taps on the divider, it should be possible to null out the signal entirely if the array is not being influenced by other objects in the area. The receiver gain should then be increased until no further improvement can be made. Front-toback ratio should be well over 60 dB when properly adjusted. On a Hallicrafters SX-111, the signal dropped from 40 over 9 to S-3 after careful adjustment.

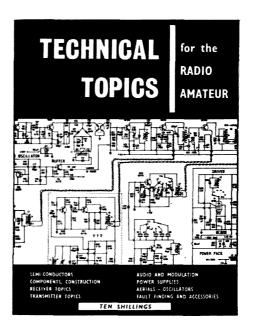
While most S-meters may tend to exaggerate, this is a substantial difference. Unfortunately, the front-to-back ratio will not be nearly as good on skywave signals. It is worst on extremely close signals (under 300 miles) and on strong broadcast stations whose signal apparently arrive from several directions at once.

After final adjustment, touch up L1-C1 for lowest SWR. If the SWR is still too high, the input may be matched with an additional network, however, the SWR of the installation shown was 1.3:1 and this was not felt necessary.

As described, the array only allows two primary directions. Although not tried, a second relay could be installed to short out the 180° phasing line which would give a bi-directional pattern broadside to the array. If an additional set of contacts were used to disconnect element 2, slightly more gain would probably be obtained (4 dB or so), but the effect of the floating element on the side nulls is not known.

The array has been in use for over three months and the results have been very satisfactory. A similar array is planned for 75 meters in the near future. . . . K8DOC

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Hamateur Acoustics

Have you ever noticed, when copying another station, some types of signals seem to bounce around the operating room? And have you ever noticd in the background of a phone station you can hear kids yelling, doors slamming, telephones ringing and other miscellaneous noises? Sure you have, and naturally all of this makes for harder copying. It also stands to reason that if you can hear background noises in other stations they can hear background noises on your signal. To eliminate some of these headache factors, why not sound condition your shack? This can be done even if the station is in the living room, den or family room. But if you have your own little cubby-hole away from the cares of the world, such as the basement or attic, so much the better.

Even though the term sound-conditioning was used, why can't we say noise conditioning? Isn't it one and the same? Well, yes and no. Sound is usually defined as being a wavetrain or series of periodic pulses having a definite pitch, such as good copy from a CW station. Noise is usually defined as a series of non-periodic pulses having no definite pitch, such as QRN behind that CW or phone station. Some acoustic engineers break it down even a little further as, "Whats one man's sound is another man's noise." So sound and noise are and are not the same.

Assume that you are copying a nice clean phone station, with no background noise, atmospheric or otherwise, when all of a sudden a plane flies overhead, or a heavy truck goes down the street. All at once you have noise that is both distracting and annoying. Just how does this noise get into the building anyway? Simply stated, the air is set into motion by the object, the air in turn is pulsed against the sides of the building, and the walls, acting as a diaphragm, cause the

air inside the building to vibrate. What makes the noise so disturbing is that it does not die out instantly but is reflected from one object to another. For example, if the wave hits a plaster wall, 97% of it is reflected. The reflection of noise or sound is known as reverberation. Every room or auditorium therefore has a reverberation time, which is the time necessary for the sound level to drop 60 dB from the original sound level. This time is also dependent on the frequency of the signal, or sound. That's why some of the signals you are trying to copy seem to bounce around the room. If the reverberation time is too long, new sounds and noises will be added to the old, causing a discordance. Hence, when a room is sound conditioned, it means that two basic things are being done. The reverberation time is being reduced to a predetermined value. and the reverberations are being absorbed as much as possible. Even a small room, 10 feet by 12 feet, 8 feet high, has a maximum acceptable reverberation time. The optimum reverberation time for the same room will be different for speech and music. For a room of approximately 1,000 cubic feet the maximum reverberation time is 0.835 seconds. The optimum reverberation time for speech for the same room is 0.76 seconds. See Table 1.

It was stated that a plaster wall reflects 97% of the sound hitting it. This figure is the percent of acoustic reflectivity of this surface. So the opposite would be the acoustic absorptivity of the surface, and is known as the coefficient of sound absorption, and written as a decimal. In the case of the

*The sabine is a measure of the sound absorption of a surface. It is equivalent to a perfectly absorptive surface one-foot square.

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Table 1. Various room sizes and their optimum reverberation times for speech and music. The reverberation times are given in seconds; room size in cubic feet.

Room Size	Max. acceptable reverberation	Optimum music	Optimum speech & music	Optimum speech
1,000	.835	.835	.817	.76
2,000	.905	.88.	.84	.769
5.000	1.02	.976	.89	.775
10,000	1.12	1.07	.93	.78

plaster wall the coefficient would be .03 sabines.* Table 2 gives the coefficients of some of the more commonly found objects in the home. The figures given are for 512 Hz and are considered the average, since the coefficient will vary with frequency. The lower the frequency, the lower the coefficient. The total number of sabines of a surface is the number of square feet times the coefficient. For items such as chairs and people it is not necessary to find the area, just multiply the number of units present by the coefficient. But if the chair is occupied, then subtract the coefficient of the chair from the coefficient of the person. The reason being, that the time will be different for unoccupied and occupied rooms. The formula for finding the reverberation time is:

Time
$$=\frac{.05 \text{ X Volume of room in cubic feet}}{\text{Sabines.}}$$

Let's assume we want to sound condition the room mentioned above; 10' x 12' by 8' high. This gives 960 cubic feet (1,000 cubic feet for our purposes) in this example. Also we want the room designed for the optimum reverberation time for speech. First we have to find the basic reverberation time. Again let's assume that the walls and ceiling are plaster board and the floor is varnished oak. There are two windows, closed, each 3' x 5' and a closed door, painted pine, 3' X 6½'. Using Table B for the coefficients we have:

Because the glass in the closed windows, and the wood in the closed door, have for all practical purposes the same coefficient as the plaster board walls, they will not have to be considered separately. If the windows or the door were open, their area would have to be figured and subtracted from the wall area

and the number of sabines in this area would have to be added to the total of the wall. So in our problem, the reverberation time of the bare room is:

$$T = .05 X 1,000/17.76 = 2.81 seconds$$

This value as can be seen is far above the optimum value of .76 seconds.

The next step then is to consider what is going to be placed in the room when it is furnished. Of course there will be the person operating the station, the transmitter, receiver, and other gear, an operating desk, a chair, framed certificates, a rug, and curtains at the windows. By refering to Table 2 again we can compute the additional absorption of these items.

One average male adult = 4.2 sabines 8' by 10' lined rug (80 sq ft x .2) = 16.0 sabines

Table 2. Absorption coefficients at 512 Hz of materials commonly found in the home.

18" brick wall, unpainted	.032
18" brick wall, painted	.017
Carpets, unlined	.12
Carpets, lined	.23
Celotex, imperforated, 1/2" thick	.31
Concrete	.015
Cork flooring slabs, glued down	.08
Cork tile	.06
Cretton cloth	.15
Drapes	.5-1.0
Glass, single thickness	.027
Battleship linoleum	.03
Marble	.01
Open window	1.0
Plaster on wood lathe	.034
Plaster on wire lathe	.033
Plaster board	.03
Wood, white pine, unpainted	.06
Wood, white pine, painted	.03
Oak flooring, varnished	.03
Human, average male adult	4.2-4.7
High school student	3.5-3.8
Average female adult	2.3-2.5
Upholstered seats, thick plush	1.0-4.5
Wooden chairs	.12
Masonite, on 2" x 4" studs 16" o.c.	.32
•	

Operating desk, painted pine 6'x3'x3' (consider it a box)

= 54 sq ft x .03 = 1.62 sabines

One wooden chair, painted = .2 sabines

One upholstered chair, average
size seat = 3.0 sabines

Radio gear, assume 12 sq ft of
surface 12 sq ft x .01 = .12 sabines

Two curtains, cretton, 6'x4' draped
and folded to cover entire window

48 sq ft x .15 = 7.20 sabines

32.34 sabines

As with the glass in the windows, we can disregard the framed certificates because of the coefficients. Now the room will have 32.34 plus 17.76 sabines or a total of 50.10 sabines. The reverberation time will now be: $T = .05 \times 1,000/50.10 = 0.99$ seconds This is still too long by .23 seconds from the optimum time of .76 seconds and still too high for the maximum reverbration time.

For all practical purposes though, we could stop here and say that the room is now correct. The reason is that the total area of the room is small and in the future things will be brought into the room, such as books, paper, and maybe an additional chair. But for the purpose of our example, let's continue as if nothing more will be added to the room in the future. Then the additional sound absorbing material needed



Bah-wireless!!!

can be found by transposing the formula to give:

Absorption needed = 0.5 V/T = .05 X 1,000/0.76 = 65.78 sabines

65.78 minus 50.10 equals 15.68 sabines needed in additional material. Let's say we decided to use a wall covering to get the needed absorption, so to find the number of square feet to be covered:

15.68/coefficient of material to be used.

By using the table of coefficients and doing a little figuring we can see that it might become difficult. Suppose that plain celotex is decided upon then 15.68/.031 would give 50.5 square feet that has to be covered. This is less than the square foot area of any of the walls or ceiling. We could cover just part of a wall, but the appearance would look odd. However, and again assuming, suppose that both windows are in one of the 10' walls, then 80 square feet minus 30 square feet, both windows, give a remainder of 50 square feet. This wall could be covered, disregarding the remainding half-foot of material needed.

Another solution would be to change something already in the room, such as the curtains. Instead of using cretton curtains, why not use drapes. By using material which is not too heavy, something that might have a coefficient of 0.3, we get the following: 48 square feet of curtains times .3 equals 14.4 sabines. The room would now have:

17.76 sabines in basic room 39.54 sabines from the furnishings 57.30 sabines

The reverberation time would now be:

 $T = .05 \times 1,000/57.30 = 0.87$ seconds

Then this gives a difference of only .11 seconds above the optimum time. This is assuming that the drapes are closed, covering the entire windows. If the drapes were made longer, from ceiling to floor, then this would correct the time. By opening the drapes we now have a method of varying the amount of absorption and time, if it has to be done. The greater absorbency of the drapes will mask the absorbency of the walls and windows they cover to some extent. However, if the drapes are not tight against the walls and windows, some sound will get behind

them and be absorbed. So it is not necessary to subtract the area of the walls covered by the drapes.

If you decide to sound condition the room as if it were a radio studio, then the optimum time changes. For a radio studio the most satisfactory time has been found to be about two-thirds the optimum time for speech. For a music recording studio the time is about two-thirds of the optimum time for music. These figures only hold if the residual noise in the room does not exceed 5 to 10 dB.

If the shack is in the living room or den most of the needed absorption can be made up in drapes and upholstered furniture. The XYL will be more than glad to pick these items out for you. When the station is in the attic it would be wise to remove the floor and install rock wool or fiber glass mats between the joists. When reinstalling the floor get the joints butted together as tight as possible, or use tongue and groove flooring. It is surprising how much sound can get through cracks. If it is impractical to remove the old flooring, install a false floor about two inches high with the mats beneath it. This will not effect the coefficient of the

floor, but it will help dampen any vibrations that the floor, acting as a diaphragm, would transmit to the ceiling below. As for the basement, the ceiling should be treated in a similar manner, installing fiber glass mats between the joists before covering with any acoustic tile.

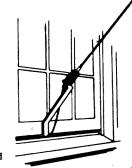
Any noise carried through heating ducts between rooms, can be attenuated to a great degree by lining the inside of the ducts with a sound absorbing material. Use either fireproof tile or fiberglass, held in place by glue or some form of staple.

When buying any acoustic tile, make sure you get the coefficient number from the manufacturer's literature. Also, try to get material which will not have to be painted later as this will reduce the coefficient by 15%. This should have been taken into account with the plaster-board walls mentioned in our example because the walls would have been painted at the time of construction, but it was not figured for ease of computing. The 15% would not reach full value until about three coats of light weight water base paint has been applied, or two coats of heavy oil paint.

... W3RZD

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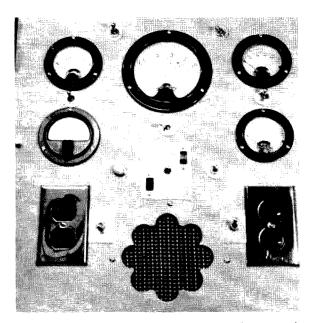
DPZ CORPORATION P. O. BOX 1615 - JUPITER, FLORIDA 33458

DECEMBER 1967

A Workbench Clutter Filter

Cluttered work bench? Try this surefire bench clutter filter designed by WA6UVS.

Anyone who has ever breadboarded an electronic circuit knows well what a prodigious mess this endeavor can spawn on the home workbench. Commonly this same brambly mess can become not only unsightly in appearance but also physically dangerous, as I am sure a good many people can testify. Described here is a simple device which will assist measurably in preventing a good part of the unpleasantness from ever developing.



Note that the individual input receptacle to each of the four ammeters is not shown on the photograph. The reason for this is that I did not recognize the desirability of this feature until after the photograph was taken. All 'on'—'off' switches are turned 'on' by pushing the switches 'up'. All meter selector switches position by actuating toward the desired meter.

Drawn on a sheet of paper as a schematic, a simple one-stage amplifier will appear beguilingly simple, but once this schematic has been fleshed out into electronic bone and tissue on the breadboard, one begins to wonder where the simplicity went.

The gadget outlined here represents an attempt to clean up a lot of loose odds and ends about the workbench and confine them to a handy panel assembly on the premises. Its development was promoted by various unpleasant encounters with almost every breadboard assembly I have ever built.

The proverbial final straw was loaded aboard about a month ago. On that day I had an errand to perform, one of those itchy things dreamed up by the XYL. However, since "H" hour was some 45 minutes away I figured this gave me just enough time, if I hurried, to run some tests on a group of 1619's that happened to wash up on my personal beach. Out came the power supply, the filament transformer, the voltmeter, 2 ammeters, an output transformer and a speaker. These were all hurriedly arranged, each in its respective place and all nicely tied together with a bird's nest of hook-up wire. The last item of the array was the speaker which I intended to hook into the circuit with alligator clips. With a glance at the clock to see how much time was left, I leaned over the workbench like a bullfighter over a bull and plunged home the two alligator clips, all the while keeping half an eye on the clock.

As it developed, half an eye was all I could muster some seconds later as I pushed a good part of the scrambled equipment

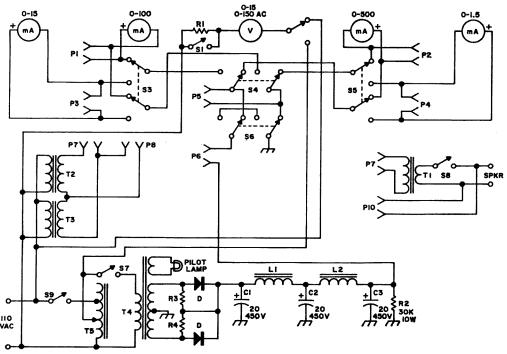


Fig. 1. Wiring diagram of the workbench clutter filter. This gadget is handy and guaranteed to clean up your workbench!

off my chest, struggled to my feet, cut all line switches, and thankfully staggered off about that errand. I don't know into what part of that seemingly innocuous plethora of wire my alligator clips were slipped, but, certainly, it was not the voice coil of the output transformer.

Later, having performed the errand for the XYL and in the process recovered a portion of my shaken nerve, the tests were continued toward a result which included not only tube curves but also a couple of charred filament wires, an abused ammeter and a throbbing elbow. The latter got that way from having richocheted from a B plus off the workbench shelf.

These, then, were the conditions under which the Workbench Clutter Filter was conceived and built.

The assembly consists of three separate parts. The first of these is the power supply which is variable from approximately 0 volts to 400 volts and is controlled by a small *Variac*. Note that in order for this type of voltage control to be successful, either solid state rectifiers must be employed, as is done here, or a separate rectifier filament transformer must be used. The second part of the assembly is made up of five meters, four of which are dc types measuring from 1.5 mA to 500 mA; the fifth meter is an ac type covering two

ranges, 0-15 Vac and 0-150 Vac. The latter range is used to monitor the ac line voltage or ac input voltage to the power supply. The third part of the assembly is made up of an audio output transformer and a speaker. These latter components can be used separately or together as a unit depending on switching arrangements used. Three or more sets of leads should be fabricated for use with the assembly. These can be made from new material or from television cheater cords with the chassis ends hacked off and a pair of alligator clips soldered onto each set. These leads should all be marked for polarity, as should all meter and power plugs on the panel. (Use your XYL's best crimson nail polish for this purpose and be assured of not forgetting.)

Operation of the assembly is quite simple. To illustrate, let us return to the 'shocking' experiments which led to the conception of the assembly; the 1619 tube experiments. Plug a set of leads into the power supply, being careful to observe polarity. Connect one clip to the plate of the 1619 and the other to ground. Read plate current with the 0-100 mA meter. Plug another set of leads into the 0-15 mA meter. With a second power supply feeding through these leads screen current will be metered.

The output transformer-speaker combination can be used whenever trouble in the final audio output stage of a receiver is suspected. This is accomplished by plugging a set of leads into P9, closing (pushing up) switch S8 and attaching the clips, one to the plate of the output tube and the other to B plus. If this test clears the trouble, next remove the leads from P9 and reinsert into P10. Open switch S8. Break the speaker leads on the receiver being tested and clip the test leads on the secondary of the output transformer. These two tests will determine if either output transformer or speaker is at fault.

The remaining portion of the panel assembly, the filament transformer, is self ex-

planatory, serving only as a convenient source of filament voltage for tubes under test. As a precautionary measure, always remove test leads from the panel after an experiment has been run. It would be most easy to overlook a shorted pair of leads (clips together) and either burn out the main power supply or the filament transformer.

This about wraps it up. If your clutter filter contributes as much toward the contentment and well-being of your shack as it has mine, you may have to start a fight with the XYL to generate some excitement.

... WA6UVS

Table 1. Parts list for the clutter filter.

- C1, C2, C3—20 μ F/450V electrolytics
 - D—For 800 Vct transformer use sufficient number of diodes to produce a value of 1200 PIV in each leg plus one diode as a fudge factor. I used Sarkes-Tarzian F-6 diodes in each leg.
 - L1, L2—Whatever is available: I used I Henry units from old TV power supplies.
- PI thru P4—Single 110-volt female receptables used as individual inputs to each of the meters.
 - P5—Same as P1 used as input to any of the four ammeters.
 - P6-Same as P1 as B-plus receptable.
 - P7, P8—Double 110-volt female receptable; P7 is 12-volt outlet and P8 is 6-volt outlet.
 - P9. P10—Double 110 volt female receptable;
 P9 is input into output transformer.
 P10 is input into speaker.
 - RI—Meter multiplier resistor; select for particular meter used.
 - R2-30k ohm, 10 watts.
- R3, R4, etc.—About 400 to 500K ohms across each rectifier diode.

- \$1-SPST toggle switch. Meter multiplier.
- **S2**—SPDT toggle switch. ACV meter selector, line voltage or auto-transformer output voltage.
- S3. S5—DPDT toggle switch. Meter selector switch.
 - **S4**—DPDT toggle switch. Meter branch selector switch.
 - **S6** DPDT toggle switch. Inserts selected meter into B-plus circuit.
 - S7—SPST toggle switch. B-plus control.
 - S8—SPST toggle switch, Permits use of speaker without input transformer.
 - TI—Audio output transformer. 4.5k ohms to 3.2 ohms primary to secondary will probably prove most useful.
- T2. T3—Filament transformers, 6.3 volt, current rating as desired.
 - T4—800 VCT, 200 mA power transformer with at least one filament winding to power pilot light.
 - **T5**—Variable Auto-transformer. I use a 500-watt unit.
- Pilot Light—6.3-volt or 12.6-volt to match the winding on T4.

General Information About Amateur RTTY

The number of radio amateurs using teleprinters on the air is increasing at a great rate. Each of these new amateurs is faced with many technical problems which must be solved. Some are fortunate enough to live near an already established amateur teleprinter station. For those not so fortunate, there has been a great need for down-to-earth information on the manner in which one goes about entering the ranks of the current operators. The comments here recorded have been assembled to assist those amateurs who are in need of fundamental information and instructions.

The information which follows is not intended to answer all of the questions that may arise. There are several publications available which go into the details of the teleprinter machines and how they operate. Interested amateurs should acquire these sources of information and read them carefully. It is hoped that the information presented herein will enable those who are interested to make better use of the existing publications.

Types of machines

There are many different types of teleprinter machines, manufactured by different companies. Many of the ones available to hams have been manufactured by the Teletype Corporation. For example, the models 12, 15, and 19 are frequently found in amateur circles. Many people who enter into RTTY select the model 19 because it offers flexibility at a reasonable cost. The

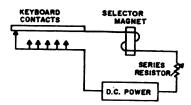


Fig. 1. With the local loop shown here, the teletype operator can type on the keyboard and activate the printer for printing.

flexibility results from the tape equipment which is an integral part of the model 19 while the cost is moderate because of the machine's age. (One can purchase a model 19, pre-tested and shipped to the door, for approximately \$150.00). Other models, such as the model 15, which does not include tape equipment, can be acquired for considerably less. On the other hand, for those who can afford the very finest, model 28 machines are available.

Tape equipment

When we speak of "tape" we are referring to the 5-channel paper tape that can be used to store information for later use. Information can be placed into paper tape using a paper tape punch. The information is then saved until it is later read by a paper tape reader. The information contained on the tape can be alphabetic, numeric, and/or control. By control information, we mean information capable of performing such functions as ringing a signal bell, advancing the paper in the typer, or returning the typing unit to begin a new line. All of this information is stored on the tape in the form of punched holes which by their position and number indicate the particular character of interest.

Tape equipment is popular in the RTTY field, because it enables one to prepare messages ahead of time and to send them automatically when desired. This is accomplished by punching the messages into paper tape and then later reading them with a paper tape reader at a high speed (approximately 60 wpm). Many amateurs enjoy calling "CQ" by using tape equipment to send out the signals which, when received, generate the normal type of CQ format, i.e., CQ CQ CQ DE WAØOBJ K K K. The tape equipment thus represents a way of transmitting from a teleprinter machine without actually doing the typing at the time of transmission.

The model 19

The model 19 can be thought of as having 6 essential parts:

1—a model 15 page printer

2-a keyboard capable of transmission to an outside circuit, a paper tape punch, or both simultaneously

3-a paper tape punch

- 4-a paper tape reader and transmitter
- 5-a sturdy table containing power distribution connectors

6-a suitable dc power supply

The above six parts, when properly connected, enable the operator to perform the following functions:

- 1-receive incoming messages on the page printer
- 2—prepare paper tapes while receiving incoming messages
- 3-prepare paper tapes while simultaneously transmitting directly from the keyboard
- 4-transmit from the keyboard to external circuits (while transmitting, the information can be printed on the printer or can be transmitted "blind")
- 5-transmit from the paper tape reader (see #4)
- 6-receive on the printer while transmitting with either the keyboard or tape transmitter.

Function 6 is especially interesting for it enables one to operate in a simulcast mode. The discussion which follows will not be concerned with this mode of operation. Persons interested in exploring this type of operation should consult the more advanced publications covering RTTY configurations.

How the machines work

The teleprinter is activated by releasing the printing mechanism. This is accomplished by de-energizing the selector magnets. In the model 19, the selector magnets are located on the left-hand side of the machine. With the printer motor running, the printer unit is maintained inactive as long as the printer magnets are energized. When current ceases to flow, the magnets release. If the current is interrupted according to the "teletype code", the printer will be activated and the appropriate character will be printed. The more detailed publications explain the manner in which this is accomplished.

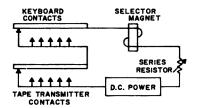


Fig. 2. With this local loop arrangement, the printer will print from either the keyboard or the tape reader.

The selector magnets can be wired in series or parallel. In general, they are wired in parallel. The magnets are energized with direct current-60 mA being required for proper operation when wired in parallel. The model 19 is generally supplied with an appropriate power supply which will furnish the current necessary for the selector magnets and also the tape punch and tape reader. The supply is in general capable of supplying 120 volts at 800 mA (1200 mA intermittent) and may carry a Western Electric identification of KS-5928. The resistance of the selector magnets is low and a series current limiting resistor is required when using the 120 volt supply. Do not attemp to operate the unit without the series resistor. The magnets will overheat in a few minutes time and will burn out shortly thereafter! A variable resistor is desirable so that the current can be adjusted when the unit is periodically serviced. A suitable resistor would be a 2500 ohm unit rated at 20 watts.

The selector magnets do not have to be operated with a high voltage dc supply. Low voltage supplies will work quite well and reduce the danger associated with the higher voltages. The main advantage of using high voltage is the self-cleaning of contacts which takes place due to the slight arcing.

A local loop

In teleprinter installations, a closed circuit is referred to as a loop. Thus a "local loop" is a closed circuit which encompasses equipment in your local area, i.e., only your machine. A local loop could consist of a printer and a keyboard or a printer and a paper tape reader. To set up a local loop with your model 19, you will have to locate the leads connecting to the selector magnets, the keyboard, and the paper tape reader-transmitter. Details on how to locate these leads will be presented later in our discussion.

The inter-wiring required for successful

operation can be greatly simplified by thinking of the units performing like the following components:

Printer—an electromagnet which is normally energized
Keyboard—a SPST switch which is normally closed
Tape Reader-Transmitter—a SPST switch which is normally closed

With the above understanding of the units, we can immediately wire a local loop containing the keyboard and printer. The loop would be a series circuit containing the following elements:

1—the keyboard SPST "switch"
2—the printer's electromagnet
3—a current control resistor
4—a source of direct current

Such a circuit is shown in Fig.1. Since the keyboard "switch" is normally closed, a current will flow through the selector magnets keeping them energized with an amount of current governed by the setting of the current control resistor. When a key on the keyboard is depressed, the normally closed contacts will be interrupted momentarily. This will cause the selector magnet to de-energize and thus activate the printing mechanism. Note that the circuit is not simply opened and then closed again. The actual interruption may consist of several openings and closings-the number and spacing depending upon the character being sent by the keyboard. A complete discussion of the "teletype code" is presented in several of the detailed publications.

With this simple local loop, one can type on the keyboard and have the characters displayed on the printed page by the printer. Now observe that the tape transmitter is simply another normally closed switch. If the above loop is opened and the tape transmitter inserted, we would have a new loop in which the printer could receive from either the keyboard or the tape transmitter. Just as depressing a key on the keyboard causes the circuit to be interrupted momentarily, so passing tape through the tape reader causes the same thing to happen. Such a loop is shown in **Fig. 2**.



Fig. 3. Color coding of the switching jacks found in the Model 19. With the plug inserted, connections are made to red and yellow.

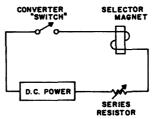


Fig. 4. Installation of the RTTY converter in the local loop to energize the printer from received RTTY signals.

Comments on unit wiring

Although you will find several publications showing a wiring diagram for the model 19, this does not imply that your model 19 will be wired exactly as shown in the diagram. At first this sounds as though it would pose great problems. However, a few minutes spent exploring the machine with an ohmmeter will pretty well identify the necessary wires.

In general, you will find two wires coming from the printer which are terminated with phone plugs. One will be red and the other will be black. It is these wires which you will want to examine with an ohmmeter. Sometimes one is the keyboard while the other is the selector magnet. Other times, the two centers of the plugs are the one unit while the two outsides are the other. You will have to study your machine to determine exactly how it is connected.

Switching jacks are provided for the phone plugs. These jacks are mounted in the model 19's table along with the various power connectors. Fig. 3 shows how the jacks are wired and color-coded.

Assuming that you are using the standard Western Electric KS-5928 power supply, the power connections are straight-forward. On the back of the table, you will find various sockets that will accept only special keyed plugs. These plugs are contained on either the power supply unit or the printer.

The power from the incoming line is supplied to the power supply by the toggle switch located under the table top (left hand side). This switch represents the main power switch for the entire teleprinter machine. The printer's motor is controlled by the "on-off" switch located on the front of the printer. Some units also have a switch to control the ac to the tape reader's motor. If your machine does not have such a switch one should be installed.

Provision is made for mounting a switch in the box containing the general power switch mentioned above. If your model 19 does not have the switch for controlling the tape reader's motor, you will find that one wire comes into the switch box, loops around, and then goes back out. The new switch should be inserted in this loop.

The "on-off" switch mounted on the front of the tape reader-transmitter is not a power switch controlling the ac drive motor. The switch is connected in series with a solenoid used to maintain the transmitter inactive. If you lift off the cover of the transmitter, you will find a large solenoid located near the front, on the left hand side of the unit. If this solenoid is energized, the motor will turn the vertical shaft and "read and transmit" the information contained on paper tape. Thus to send from tape, two sources of power must be connected to the tape reader-the ac power to the motor and the dc to the control solenoid. The dc for this solenoid is distributed via the printer's inter-unit switches (see next section).

Inter-unit operation

There are several modes of inter-unit operation possible with the model 19. We indicated before that one must identify the leads coming from the keyboard and selector magnet. We implied that they were directly connected. Actually, there are switches installed in these lines. You will find three switches on the front of the printer. The one on the far right is the "on-off" switch for the printer motor. The motor must be turned on to either receive with the printer or to transmit with the keyboard. It does not have to be on to punch tape (blind punching). Now observe the switch on the left hand side of the printer. This switch is connected in series and in parallel with the keyboard. In the "send" position the keyboard is connected to the out-going wires. In the receive position, the keyboard is shorted (bypassed). In the "break" position the keyboard circuit is opened. The remaining switch, located slightly left of the printer motor power switch, selects the mode of transmission that will take place from the keyboard. Thus, if in the "keyboard" position, transmission will take place from the keyboard to the outgoing lines. In the "keyboard and tape" position, transmission goes to the outgoing line and the information being typed is simultaneously punched into paper tape. When placed in the "tape" position, the keyboard will punch tape but will not transmit to the out-going line. It is in this mode of operation that the printer motor need not be running.

We should now note some interactions which take place between the paper tape reader-transmitter and the above mentioned switches. If you want to send something, whether it be from tape or the keyboard, the "send-rec-break" switch must be in the "send" position. Furthermore, if you want to send from paper tape, the "keyboardkbd/tape-tape" switch must be in the "kbd/tape" or "tape" position. Also, when transmitting tape, remember to turn the "solenoid switch" to "on". Note: Some tape transmitters have other switches connected in series with the solenoid switch. These include switches to stop transmission if there is no tape in the reader, etc.

Radio teletype

Up until now, we have concerned ourselves with the machines used to send and receive teletype. But we have not talked about applications involving anything other than a local loop. Certainly the fascination of typing on an over-sized typewriter will wear off quickly. Let us then pursue the reception of teletype signals and the manner in which they can be used to activate a teleprinter machine.

You will recall that we said the printer was activated by interrupting the flow of current through the selector magnets. It then follows that if we could get the receiver to interrupt the flow of loop current in step with the intelligence being received, we

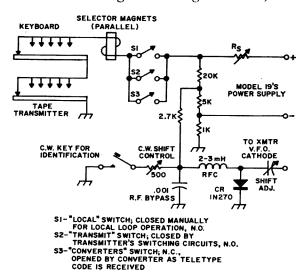


Fig. 5. The "Mainliner" frequency-shift keying circuit described by K8DKC in the May 1965 issue of QST. The resistor R_{\ast} is adjusted for 60 mA through the selector magnets.

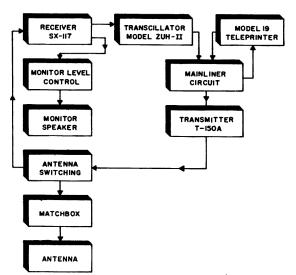


Fig. 6. The station setup used at WAØOBJ.

would have a set-up capable of receiving teletype signals and converting them into the printed word. If the teletype signals were transmitted in a make-and-break fashion, we could, for example, rectify the receiver audio output and apply it to a normally open relay (So long as the signal was present, the relay would be energized and the contact would be kept closed). Thus when the audio ceased, the relay would open the loop to the printer and de-energize the selector magnets and printing would take place. Such a circuit, although lacking many desirable characteristics, can and indeed is used by some amateurs.

In general two types of teletype transmission are employed by amateurs: frequency shift keying (fsk) and audio frequency shift keying (afsk). Frequency shift keying is accomplished by adding and subtracting a small amount of capacitance at the cathode of the transmitter's vfo. The addition and subtraction are done in step with the conditions existing in the local loop. The addition or subtraction of capacitance to the cathode of the vfo causes it to shift its frequency of oscillation. Thus, if current is flowing through the selector magnets, one frequency is transmitted. If current is not flowing, the alternate frequency is transmitted. Thus the condition existing in the loop is constantly indicated by the frequency being transmitted. In audio shift keying, the same theory applies except two audio notes are transmitted to indicate the conditions existing in the loop. This is accomplished by switching the transmitter's audio input from one audio oscillator's output to that of another.

The devices used to convert the received

teletype signal into pulses capable of operating the printer magnets are called converters or terminal units. There are many different unit circuits available and the literature abounds with information about them. Some converters process the audio output of the receiver while others process the signal existing in the if section of the receiver. The output of the converter amounts to a switch which is either open or closed. As soon as you recognize this fact, you should realize that the converter is very similar to the keyboard or tape transmitter so far as its function as a circuit element. Since the converter output is just another SPST switch, we can set up another series loop containing the converter's "switch", the selector magnets, the series limiting resistor, and a source of direct current. See Fig. 4. As the receiver's output changes in step with the intelligence being transmitted, the converter's "switch" will open and close and thus set up current changes in the receiving loop identical to those existing at the transmitting station.

To keep the converter from responding to signals other than the one desired, it is equipped with various filters which are designed to reject the unwanted frequencies. A full discussion of converters and filters can be found in the existing detailed publications.

To summarize, transmitting involves converting the make-and-break in the local loop into either a shift in transmitter carrier frequency or a change in the audio note transmitted. Receiving involves converting the change in the audio frequency received (audio type converters) into a make-and-break signal for the receiving loop. (Note that in receiving fsk the receiver's bfo is turned on and beat with the incoming signal just as in receiving CW signals.)

Shift circuits for FSK operation

Various shift circuits are available and have been presented in the literature. One very flexible circuit is that called the "Mainliner" which was presented in the May 1965 issue of QST in the article by Irvin Hoff. This circuit uses a small diode in a diode switching circuit to add or subtract the capacitance to the vfo cathode. The circuit is shown in Fig. 5. The model 19's power supply can be used to power the circuit.

The circuit's operation centers around the voltage drops appearing across the various resistors. With the loop closed, a voltage of

a given polarity exists across the diode. Opening the loop (sending a character with the keyboard or tape) causes the polarity across the diode to reverse. As the polarity changes, the diode either conducts or does not conduct. Thus the diode either shorts the capacitance applied to the cathode to ground (thus connecting it into the circuit) or "disconnects" the capacitance by allowing the one lead to "float".

Station setups

No doubt every amateur teletype station is set up differently. A typical set up is shown in Fig. 6. The author has used a similar arrangement and has found it quite satisfactory. Once the basic principles are understood, one can design any configuration desired.

Conclusion

Although teleprinter machines may vary in detail, the basic principles are all the same. A basic understanding of the manner in which the machines operate, coupled with the electrical competence required for the general class license, should enable the interested amateur to install and successfully operate an amateur radio teletype station.

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Heater, for Unipotential Cathode		1
Voltage AC or DC	6.3 ± 10% V	6.3 ± 10%V
Current at 6.3 Volts	0.6A	0.6A
Direct Interelactrode Capacitance	1	1
Target to all other Electrodes	4.6pf	4.6 pt
Spectral Response	See curve	See curve
Focusing Method	Magnetic	Magnetic
Deflection Method	Magnetic	Magnetic
Overall Length	6.25°±0.25°	6.25*±0.25*
Greatest Diameter	1 125°±0 010°	1.125* ± 0 010*
Operating Position	Any	Any
Base	Small Button Ditetrar 8-pin	Same as 7038
MAXIMUM RATINGS	ı	
(Absolute-Maximum Values)		
For Scannad Area of 1/4"×3/4"		
Grid No. 4 and Grid No.3 Voltage	750V max.	750V max.
Grid No. 2 Voltage Grid No. 1 Voltage	750V max.	750V max.
Negative Bias Value	300V max	300V max
Positive Bias Value	OV max.	OV max.
Peak Heater-Cathode Voltage		0,
Heater Negative with Respect to Ca		125V max.
Heater Positive with Respect to Cat		10V max.
Target (Signal Electrode) Voltage	100V max.	100V max.
Dark Current	0.25μA max.	0.25 µA max.
Peak Target Current	0.55μA max.	0.55μA max.
Faceplate Illumination	10,000ix, max.	10 000 1
Temperature	71°C max.	10,000 ix. max. 71°C max.
TYPICAL OPERATION	, , , , , , , , , , , , , , , , , , , ,	
For Scanned Area of 1/2"×3/2"	1	
Faceplate Temperature of 30°C~35	°c	
Grid No. 4 and Grid No. 3 Voltage	250~300V	250~300V
Grid No. 2 Voltage	300V	300V
Grid No. 1 Voltage for Picture Cutoff	-45~ 100V	45100V
Average "Gamma"	0.65	0.65
Visual Equivalent S/N Ratio (Approx.)	300 : 1	300:1
Min. Peak to Peak Blanking Voltage	1	
When Applied to Grid No. 1	75V	757
When Applied to Cathode	20V	20V
Field Strength at Center of Focusing Coil	40 gausses	40 gausses
Field Strength of Adjustable Alignment Co Resolution at Center	oil 0~4 gausses 600~900°TV lines	0~4 gausses
Maximum Sensitivity Operation	600~900-14 lines	600~900°TV lines
Faceplate Illumination	10 tz.	
Target Voltage	50~100V	1 ix. 30∼70V
Dark Current	0.2 sA	0.2 nA
Signal Output Current	0.25#A	0.2#A 0.15#A
Average Sensitivity Operation	1 0.53,20	U.15,87
Faceplate Illumination	150 lx.	10 ix.
Target Voltage	30~50V	20~40V
Dark Current	0.02 _μ A	0.02µA
Signal Output Current	0.4 µA	0.2 _n A
Minimum Lag Operation		· I
Faceplate Illumination	500 lx.	50 lx.
Target Voltage	20~30V	10~20V
Dark Current	0.004#A	0.004 µA
Signal Output Current	Αη.Ε.Ο	0.2 _P A

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Computer Card Construction

Using surplus computer boards and sockets in homebrew construction.

Printed circuits and miniature construction techniques have been used for ham projects for quite some time now; however, most hams who use these techniques fail to make full use of them by building their circuits on plug-in type computer cards. By utilizing these cards, the ham has at his finger tips instant inter-changeability, instant access for repair or replacement, and a means of including a temporary circuit in a piece of gear today for replacement tomorrow with a newer version. In addition. surplus computer cards are readily available and inexpensive. They provide cheap, convenient, and even disposable bases on which transistorized and miniaturized gear may be constructed.



Salvaged printed circuit boards and socket.

Obtaining the cards and sockets

If you are fortunate enough to be able to get to an electronic junkyard, such as those found in New York, Providence, and Boston, then you should have little trouble obtaining computer cards with sockets; in most cases sockets will have to be dissected from some small piece of computerized gear which might otherwise be unuseable. Virtually any type card and socket pair will do as long as they are mating. Most cards obtainable will be printed circuit boards with small components mounted on them. Some boards may be quite large and may contain octal type vacuum tubes. Again, the type of card isn't too important as long as mating sockets are obtainable. However, it is advisable to choose one type card and its mating socket as a standard so that full advantage may be taken of inter-changeability. If you are unable to obtain cards and sockets from a surplus supplier, than you may purchase them new from an industrial supplier at increased cost. One type of card is called a Vector Plugboard. This board and its mating socket are available from most electronic supply houses.

Building a Card Frame

After obtaining the cards and sockets, the first step is to build a card frame. The

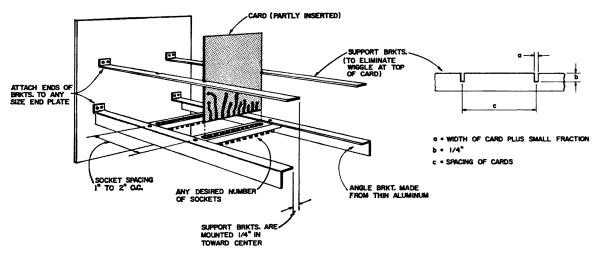


Fig. 1. Construction of a card frame to hold surplus computer cards and connectors. Although provision for only two cards is shown in this drawing, almost any practical number of cards may be held in one frame.

card frame consists of a series of sockets mounted on two metal strips. The computer cards when finished are plugged into the sockets in this frame. It is difficult to specifically describe how to construct the card frame since you may wish to use one of a variety of cards and sockets. However, Fig. 1 shows a unit which can be used as a general pattern.

The photograph shows the particular card frame which I built using sockets with 17 connections and cards measuring 3" by 4½". Spacing between sockets was I½ inches to allow room for bulky cards. Although the photograph shows a card frame with room for two cards, a frame may be constructed which may hold any number of cards. In some instances, the cards may wiggle noticeably in the sockets. If this occurs, a pair of support brackets should be installed as shown in Fig. 1. Materials for my particular card frame were obtained from surplus tuning units.

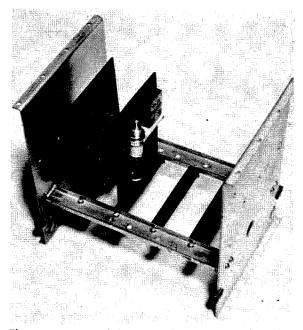
Wiring the cards

The first step before actually building a circuit on one of the cards is to unsolder and remove all components from the cards. After this is done, the card will be blank except for several metallic connecting strips. With a little forethought, it may be possible to utilize some of these strips, so before removing any strips, take some time and map out your project to best utilize existing wiring. Undoubtably, some of the metallic strips will have to be removed before the cards can be used. To do this, carefully cut the foil strips to be removed about 1"

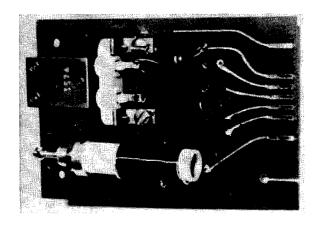
above the printed connector. After cutting, the strips may be removed by using a knife and carefully peeling away the unwanted foil.

To wire the cards, several precautions should be observed. First, when drilling use a drill with a slightly dulled point to avoid cracking the card. Second, avoid using too much heat when soldering the foil to prevent possible peeling. Lastly, leave quarter inch margins on the sides of the cards in case a support bracket is used.

It is a good idea when using these techniques to make a trial sketch of the tentative



The computer card frame used by KIEUJ. If trouble is experienced with loose and wiggling cards, use the support brackets shown in Fig. 1.



Oscillator card from a hybrid computer card transmitter under construction by KIEUJ. parts placement before actually wiring the boards. By doing this, optimum parts place-

ment can be obtained and a neat appearance will be the outcome.

The photograph shows a sample circuit

wired on a surplus computer board. The circuit is the oscillator card taken from a hybrid computer card transmitter now under construction. If it seems like some of the parts are missing, it should be noted that the transistor, heat sink, and a few resistors are mounted on the other side of the card.

The techniques described are not intended to be final techniques, but are presented only to provide an introduction to the use of computer cards as a base for the construction of most any type of gear. The hybrid computer card transmitter mentioned above will be described in a later article and will show how to mount tubes on computer cards. In addition, an article is being prepared which will describe a simple 10 meter walkie talkie using computer card construction techniques.

. . . K1EUJ

Golden Bear QSL Party

During the time from 0500 GMT, December 3 through 0200 GMT December 4, 1967, each person checking into the Golden Bear Amateur Radio Net will receive a certificate. In order to be eligible for the Golden Bear Net QSL Certificate, an operator must, during his check in contact period, provide the Net Control Station, the correct call, name, and mailing address of his station. The Net frequency is 3975 kHz, and check-ins will be accepted, with or without traffic, on LSB, AM, or CW.

QSLs cards from stations who receive the confirmation certificate will be accepted with pleasure and will be placed in the hands of the Net Historian to be preserved with other records of this program.

Baton Rouge, Louisiana QSO Party

The first week in December-December 3 through December 9—has been set aside by the Baton Rouge Amateur Radio Club to celebrate Baton Rouge's 150th year. The club will award a certificate to anyone making contact with a Baton Rouge Club member during this week. You may use any mode and any frequency. To receive your Sesquicentennial Certificate, send a large, stamped, self-addressed envelope to Baton Rouge Amateur Radio Club, P. O. Box 53194, Baton Rouge, Louisiana 70805. But remember, it must be a *Club member* only.

Data Net

There seems to be an above average amount of interest in the subject of Unidentified Flying Objects among radio amateurs. Data-Net grew out of just such an interest. The net members have a serious interest in UFOs and a desire to communicate with others on the subject. It is presumed that there are a number of 73 readers who are similarly interested, but who are unaware of any organized activity, such as Data-Net. Of course, increased participation would multiply the effectiveness of Data-Net. The group initially convened about ten months ago.

Data-Net is still quite small, with something over 50 who contribute in one way or another with enough regularity to be considered full members. The net meets weekly at 0300 GMT on Thursdays (8 PM Wed. PDT) at 14.315 MHz, either USB or CW. Other frequencies are monitored at selected times. Net Control is WB6RPL and anyone interested should write him for upto-date operating information. Address letters to Michael M. Jaffe, 624 Farley St., Mountain View, California 94040.

Data-Net operates with no dues of any kind. Contributions are entirely voluntary, and they go mainly to cover mailing costs. A report is published monthly and mailed to net members. It covers operating activities, news and views on UFOs, contributions by members, etc.

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Station Accessory Control Unit

Have you ever just leaned back and looked at your shack and then realized what a conglomeration of stuff you have amassed and what a mess of wires are running all over the place? Or, has the wife mentioned it to you? Well, at this QTH the rig is stashed away in a bedroom and, as is the case with many of you I'm sure, it behooves us to keep things as shipshape as possible. After due consideration it appeared that the following items could be combined into a single cabinet and I'm sure you can do the same with yours:

SWR bridge Antenna switch and low-pass filter Phone patch Audio compressor Speaker Plate or rf meter

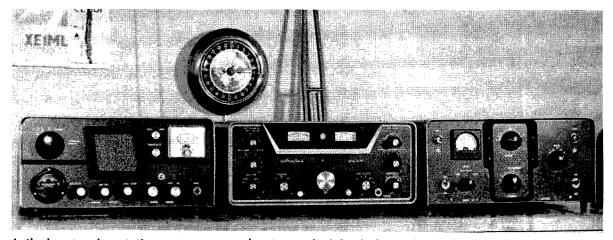
Now this will not be an electronic construction type article and we will assume you have equivalent type units that could be assembled, or disassembled as the case may be, and put into a cabinet similar to this one. What we will try to do is to present some tricks of the trade, resulting from umpteen years of building everything from

model airplanes, model railroads, magic illusions, photo equipment and numerous pieces of radio gear. So, before you give up and think that this is too hard a job for you, just read through and you will see that by taking things one at a time it is really not a very tough job at all.

Chassis

Cabinet and chassis size were determined first by a desire to match my transceiver and linear and secondly by just how much space would be required. Things worked out great with an inexpensive 3 x 10 x 14 aluminum chassis box from LMB. Now obviously, your components are not going to be exactly like mine, so the first thing to do is to gather them together, disassemble as necessary, and position them on the chassis taking into consideration best locations for incoming/outgoing signals and front and rear panel accessibility. Study the basic wiring diagram (Fig. 1) and modify it to suit your particular needs. Basic arrangement of components is shown in Fig. 2.

Now a word about some inexpensive special tools that make the difference between a cussed job and a simple job. If you don't



Author's setup has station acessory control unit on the left which matches SR-150 and homebrew copy of 30L-1 linear. Antenna switch is at top left and SWR meter is at top right. SR-150 plate meter is at lower left and lower knobs are for phone patch and audio compressor controls.

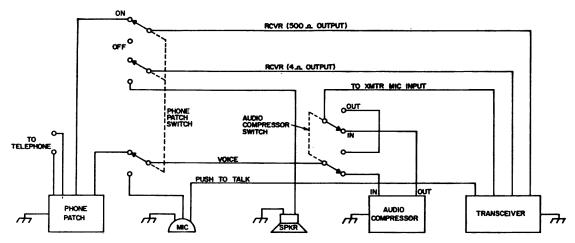


Fig. 1. Basic wiring diagram of the station control unit at K6ZHO.

have a chassis punch set and one of the Adel nibbler tools, borrow, or better yet, buy 'em now and save yourself much grief in the future. Also, a small 1/8-inch diameter rattail file and a larger 1/4-inch diameter wood rasp make repositioning holes in aluminum a cinch. A medium-weight flat file, an adjustable flycutter, and an assortment of drills will just about do the trick.

SWR bridge

Disassembly or assembly of the Heathkit SWR bridge is extremely simple and installation in the new chassis only requires fabrication of an rf shield which is constructed from .032 aluminum. If you've never tried this before the following will make the job easy for you while referring to Fig. 2:

- Mark dimensions and bend-lines on aluminum sheet.
- 2. Drill 4-inch holes at intersection of bend lines and cut metal to shape.
- 3. Use files to smooth edges and then steel wool both sides.
- 4. Cut two wooden blocks ¾ x 2% x 11½ inches to match bend lines.
- 5. Place blocks on each side of metal and clamp together tightly, being careful to hold alignment with bend lines.
- 6. Use rubber mallet to bend flanges.
- 7. Position shield inside chassis and mark its outline on chassis.
- Drill screw holes in chassis and deburr holes with file or next larger size drill.
- 9. Mark and drill holes in shield to match holes in chassis.
- 10. Cut holes for coax fittings in chassis using %-inch punch.
- 11. After drilling first \%2 screw hole for

- coax fitting, insert the same diameter nail into that hole before drilling remaining three holes to retain alignment of screw holes. Use coax fittings as drill jig.
- 12. Attach shield with 6-32 nuts and screws.

Antenna switching unit and low-pass filter

My antenna switch was assembled in a 3 x 4 x 5 inch LMB box using SO-239 coax fittings and a heavy-duty surplus 5-position rotary switch. In retrospect, the commercial Waters or Pic Polyswitches will do a better job and can be easily installed with a simple bracket. A ¼-inch shaft, a coupling and a feedthrough bushing on the front panel are all that are required. A Johnson low-pass filter is connected to the SWR bridge with a 90-degree coax elbow and a Dow double-female coax fitting, and to the antenna switch with an elbow and a short piece of RG-8/U cable.

Phone patch

Adequate space is available for almost any of the commercial makes and if a meter is required it may be installed in lieu of the plate meter shown.

Audio compressor

This unit, homebrewed from the February, 1963 QST, feeds through the phone patch to smooth down some of the excited voices and has an added in-out switch used for demonstration purposes. This sometimes provokes caustic comments from fellow hams who don't dig compressors.

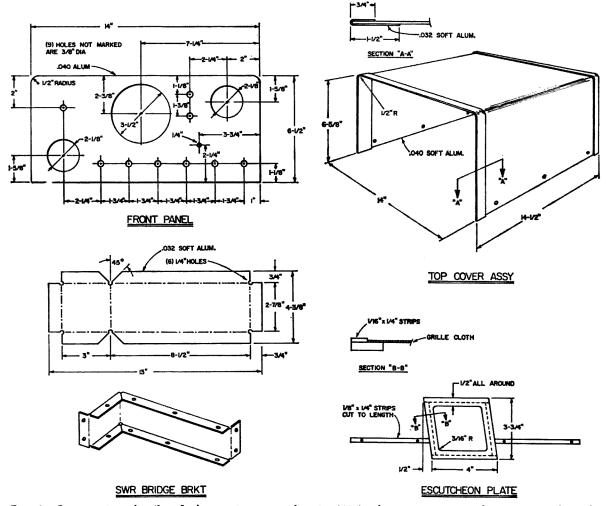


Fig. 2. Construction details of the station control unit. With this construction, the unit matches the author's other equipment as shown in the photograph.

Front panel

Because we are not having to worry about any frequency stability problems or extreme ruggedness, a sheet of .040 soft or hard aluminum can be used. Dimensions as shown on Fig. 2 can be modified to suit your needs. Using safety glasses, the meter and speaker holes were cut on a drill press using a flycutter. A tip here is to go slowly and when half-way through, stop, remove the panel, clean it off carefully, and then finish the cutting from the opposite side.

Speaker system

It may not be hi-fidelity, but it is possible to get acceptable audio from a four inch speaker if a good quality unit is purchased. For clearance, it will be necessary to provide a cutout in the chassis. This is easily done with the Adel nibbler which only requires a ½-inch hole to get started. Use flush screws for speaker attachment.

Assembly

Before assembling and wiring the unit, place the front panel against the chassis and mark location of meter, switch, etc. holes on the chassis. The meter hole is cut out using the Adel nibbler. The other holes may have to be enlarged using the ¼-inch wood rasp. Panel will be finally attached to the chassis with the switch and potentiometer nuts.

Escutcheon plate and trim strip

The escutcheon plate for the speaker was cut on a jig saw from a piece of 1/8-inch basswood plywood purchased from a local hobby shop. Edges and front surface were sanded with decreasing grades of sandpaper between three coats of lacquer sanding sealer. This may also be purchased in small

quantities at hobby shops. Several coats of glossy black lacquer were applied and the finished article looks just like metal or plastic. Trim strips were cut to length from ½ x ¼ x 36-inch pine (hobby shop again) and finished in the same manner. The speaker grill cloth was cut to shape and glued to the back of the escutcheon plate. Chrome plated ½-inch 2-56 Phillips head screws and nuts were used to hold the plate and trim strips to the panel.

Finishing front panel

After the unit has been assembled and wired, the front panel is removed, gone over with steel wool or fine sandpaper and cleaned with a strong detergent before spray painting. I used a dark grey spray enamel, applying several coats. Let it dry overnight and then gently rub the surface with light weight steel wool. Clean with a soft dry cloth.

Lettering is very simple nowadays thanks to the new dry transfer processes such as the Ami-Tron associates system which is advertised in 73 Magazine. A set of printed sheets containing common ham words is supplied and if an exact word is not found it is no trick to use individual letters to make up your own words. Several tips are in order here: (a) keep back-up tissue between transfer sheet and panel except for letter or word being transferred; (b) after transfer, use lighter fluid on cotton or Kleenex and lightly wipe over words or letters to sharpen up

edges: (c) letters are soluble in acetone or lacquer thinner so be careful what you use.

Top cover

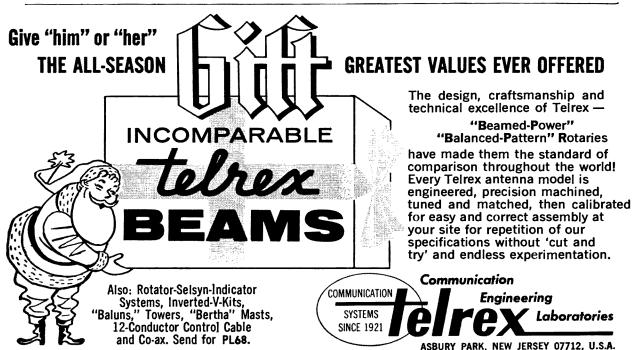
Here you will find it most helpful if you can get access to a sheet metal shop and have them shear and bend the front and rear strips. In the interests of economy don't overlook the high school or college metal shops where sometimes the instructors will be glad to let you do a simple job like this when you explain that it is a do-it-yourself project.

The front and rear strips should be first folded over into U-shaped channels and then slipped onto the flat top piece. Use a rubber mallet to fasten the strips firmly to the top. Then the top is bent around a wooden form 14-inches wide with a ½-inch radius. Here again, the secret to a good bend is a good back-up block firmly fastened in place.

The cover was carefully checked for fit, trimmed to length at the bottom and then given several coats of a light-grey spray enamel followed by two coats of clear spray varnish. A bottom cover plate was cut from .032 aluminum and rubber feet were added as a final touch.

PK metal screws, %-inch long were used to fasten the top cover to the sides of the chassis and to fasten the bottom plate. Now, by gosh, you have done it and are ready for a good housekeeping award from the wife.

. . . K6ZHO



A True Parasitic Monitor

A small simple transistorized CW Monitor which steals its operating power from the transmitter's radiated signal with perfect reproduction.

Are you an old timer who is so adept at CW that it is second nature to you If you are, then read no further since this article is not for you. If, however, you cannot work CW without listening to a sidetone monitor, then read on my friend. Perhaps this gadget will help to alleviate the situation a little.

I have tried just about every conceivable type of CW Monitor which has been written up (and a lot which haven't), and they all leave a lot to be desired. Either the tone was not a good reproduction of the generated signal or the oscillator was unstable, or the blocking diode was too small to prevent the accidental keying of the transmitter, or the battery was weak, if not dead, or, or and or. Something was always wrong.

Thus, after six years of experimenting, I think that a rather simple and practical approach has been found; at least for a while. I don't pretend to be the first to think of this particular method since oscillators are oscillators and everyone uses them. As for stealing rf power, I'm not the first to do that either, so here goes.

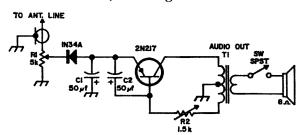


Fig. 1. Circuit diagram of the true parasitic monitor. The rf input is tapped directly onto the coaxial output connector of your SWR bridge. For power inputs over 250 watts, a small pickup probe may be used.

This monitor, I believe, could be an ideal solution. It will monitor any mode of transmission. It will reproduce the character of your fist perfectly (including the flaws). It uses no batteries, and has no power supply. It is simple, tiny, easy to build, and shouldn't cost over five dollars even without the aid of the junk box. However, if you have an old junked transistor radio around you are in business.

The monitor steals its power from the radiated signal via the feed line, and, by rectifying the rf, produces its own dc to run the oscillator. Under these circumstances it only operates when a signal is present on the feed line; one reason for the accurate reproduction of your fist. The other reason being that it actually receives your transmitted signal. I know few amateurs today who don't use an SWR bridge in the transmission line and the monitor gets its power supply, as well as its shelter, from this bridge.

The input lead is tapped directly to the output connector on the SWR bridge. This method of direct tapping will work well with all power inputs up to about 250 watts. If higher power is contemplated, the pick-up will either have to be swamped, or a different manner of pickup must be used. For high power a small loop in the vicinity of the sampler would probably suffice.

The pick-up is applied directly to the output connection of the sampler through a 5k-ohm resistor (pot) which draws enough of a load, when rectified, to produce up to 18 volts of dc. This is more than enough to operate the oscillator. All leads in the vicinity of the pick-up should be kept as

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HEY! HOW ABOUT THAT

S.W.R. BRIDGE

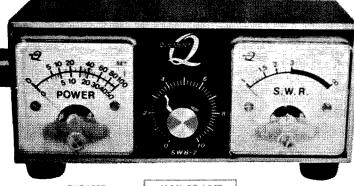
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short as possible and/or shielded (with the shield grounded) as this lashup can be a beautiful TVI generator.

The circuit is small enough to be housed in the average bridge cabinet, and could even include the speaker if you wish. I chose to run a lead to the station speaker cabinet where I nested a small 2-inch speaker to prevent cluttering up the bridge cabinet.

Potentiometer R1 is used to regulate the voltages and should be set with a VTVM prior to installing the transistor. Set the voltage at about 8 volts from the diode with the transmitter under full load. Fine adjustments for best signal can be made later but this may prevent blowing a good transistor during construction. Eight to twelve volts will produce a good solid signal. However, anything from three to eighteen volts will operate the oscillator. Any rf and most af NPN transistors will work in the circuit and PNP's may be used by observing voltage polarities. The 2N217 was used because I had one available.

Resistor R2 is used to control the pitch and also has some affect on the volume. A control for volume could be inserted in the speaker lead, if desired, but the audio level can simply be pre-set with R1 and R2 and forgotten. Both pots interact so adjustment of one necessitates the adjustment of the other. A headphone jack could also be inserted if you are an ear-muff man.

The switch is used simply to shut off the monitor during voice transmissions as it can result in feedback if it is left on near the mike. The monitor will do a pretty fair job on voice; however, the fidelity leaves a lot to be desired as the monitor was designed mainly for CW and is a very modest circuit which will not lend itself well to speech reproduction.

To use the monitor, simply fire up the transmitter and start keying. It is automatic, and once it has been tuned up will need no further attention. The monitor is dead without the presence of rf at the pickup. When used for CW, it will quickly show up the errors in your sending ability. Remember that what you are hearing is the same signal that the other fellow is trying to copy. The monitor will operate at all frequencies and will not affect the SWR.

Now sit back and enjoy working CW with no more battery problems and no more accidental keying of the rig.

. . . K4FQU

Mini-SWR Bridge

A no-holes, no-chassis construction for a simple SWR bridge that is useful for a number of tune-up applications.

Most SWR meters today are of the coupled variety which can be left in a transmission line while a transmitter is operated at full power. However, for a number of prolonged tune-up operations, involving antenna matching systems, for instance, such couplers have several disadvantages.

On 160 and 80 meters, especially, a reasonable amount of power is necessary to produce full deflection—up to 100 watts with some configurations. With a very low-powered transmitter, making adjustments at this power level certainly may damage the output tube or tank-circuit components with a high SWR. This will not be the case with higher-powered circuits but, in any case, a signal strong enough to cause needless QRM will be radiated.

Another disadvantage of the coupled SWR meter, if it is home constructed, is that it must be carefully calibrated since its re-

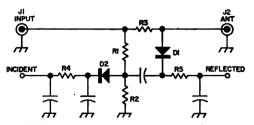


Fig. 1. SWR Bridge Circuit. See text for values of R_1 , R_2 and R_3 . R_4 and R_5 may be any matched value from 10 k to 47 k. D_1 and D_2 are IN34, IN54, or similar types. All capacitors are disc ceramic, .005 MF, 100V.

sponse is very dependent upon the mechanical configuration of the coupling circuit. This is unlike the bridge-type SWR meter (described in this article) where a standard SWR curve may be used with a good degree of accuracy.

The above factors, plus the fact that I didn't need an SWR meter continuously in the transmission line, led me to construct the little resistance type SWR bridge shown in the photograph. It is just about as simple and inexpensive a unit as can possible be built.

Construction

Two SO-239 coax chassis connectors are joined back to back by two 1½ inch threaded hex spacers. The two four-lug terminal strips are mounted at the ends of one of the spacers. The wiring of diodes D₁ and D₂ as shown in Fig. 1, should be such that the incidental voltage-measuring point appears on the terminal strip mounted on the "input" SO-239 connector, in order to avoid confusion in measurement. Short leads, of course, should be used but hardly anything else is possible with only 1½ inches between connectors.

Some attention must be paid to the components used if accurate readings are to be obtained. Resistor R_3 must closely match the impedance of the coaxial line used (52 or 75 ohms). For 52-ohm lines, a suitable re-

sistor (within ½ to 1 ohm) can usually be found from a group of standard 10% tolerance, 47-ohm resistors; and for 75-ohm lines, from a group of 68-ohm resistors. Resistors R₁ and R₂ can have any value from about 30 to 100 ohms, but it is important that they are as closely matched as possible. One trick which may be used to affect very small resistance changes is to file "V" notches in a composition resistor to raise its resistance. Two-watt units are suggested for these resistors because of their longer-term stability and endurance in case too much input power is applied.

Resistors R_4 and R_5 serve as linearizing resistors so that almost any meter with a basic movement of 1 mA or less can be used as an indicator. The lower dc voltage ranges on almost any VOM will work fine. These resistors as well as diodes D_1 and D_2 should be checked to see that they match reasonably well (the resistors within a few precent and the diodes within a few percent for their forward and reverse resistance readings).

Calibration

There are really no adjustments that can be made to the bridge, and calibration really consists of checking the balance. Fig. 2 is the dc circuit of the bridge (a simple

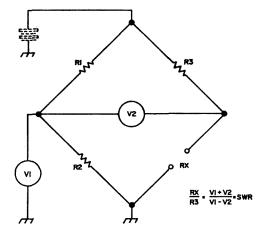


Fig. 2. Simplified diagram of SWR Bridge. V_1 represents incident voltage and V_2 the reflected voltage.

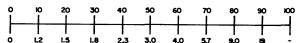


Fig. 3. SWR values for selected reflected voltage readings taken as % of incident voltage reading.

Wheatstone bridge with resistance arms). If the balance of the bridge is good, V₂ should be the same when points R_X are opened or shorted so long as V₁ is held constant. This can be checked on the actual bridge by applying an input at the highest frequency of interest (6 or 10 meters), shorting J₂, and checking that incident and reflecting voltages are the same. The same is done with J2 open. If the voltages are not equal, the difference can be taken as an indication of how accurate the SWR readings will be. If the difference is too great, R₁ or R₂ will have to be changed for a better match or the mounting of the components changed to reduce stray couplings.

A further check is to connect a known 52 or 75 ohm resistor across J_2 . The reflected voltage should, of course, read zero.

Operation

As noted in Fig. 2 the actual SWR is a simple function of the incident and reflected voltage readings. Fig. 3 presents this function in graphical form. The incident voltage is simply adjusted for some convenient value, say 10 volts reading on the dc scale of a VOM (possible with most SSR transmitters by adjusting the carrier balance control with no audio input). The reflected voltage is then read as a percentage of the incident voltage and the SWR found from Fig. 3. The input power required to operate the bridge is essentially independent of frequency, being about 1-2 watts maximum.

It should be remembered that such a bridge can measure only the resistive portion of an impedance. When using it to adjust a circuit, if a SWR minimum null but not a zero reading for reflected voltage can be obtained, it indicates some reactive component must still be present.

... W2EEY



Yes, Old Timer, There is a Santa Claus

'Twas the night before Christmas, and all through the house . . . you've all heard that one before. Well, on this particular Christmas Eve, the old timer walked into his ham shack and looked around. The shack was a reasonably large room, but it was filled with old racks of home-brew equipment. All of vintage years, which really didn't make it any better. An accumulation of parts was scattered about, and half-built projects were on every available work space. He heaved a great, weary sigh, and cleared away a space on the old desk which was scarred from years of use. He sat down, pulled out a sheet of paper and began to write.

"Dear Santa," he began,

"I'm an old man. I've been a ham for almost sixty years. I was one of the first to be licensed when the government took over, but I was busy experimenting long before that. I have always been proud that I built everything in the shack and it worked fine. All the young hams used to come to me to learn how to make things, and they all thought I was something pretty special.

"But, you know, Santa, I'm old and I'm tired. My hands aren't as steady as they used to be, so I can't hold a soldering iron very well any more. And, since my eyes began to fail, I don't read much and haven't kept up with all the new-fangled technical ideas like I used to. All the magazines keep writing about the new SSB rigs and how you can build them, but they all use the new transistor circuits, and I just haven't kept up and I don't know what they're talking about.

"Like I said, I'm getting old. All my old friends are on sideband and won't talk to me on AM. Well, let me tell you, this gets kinda lonely. I'd sure like to be able to join them on the air again, but I just don't have the money to buy one of those fancy rigs.

"What I'm getting at, Santa, is this. If you could see your way clear to bring me a SSB rig, you would make my last days real happy.

"Now, I don't want you to get the idea

that I'm asking for anything special, but I hear that the Gollings X-line is about the best SSB equipment you can get. So, if you could manage that, I'd sure be a happy man. I really need something which won't break down on me in no time. They have a real pretty console model with a desk and all. As you can see, this old desk is about ready for retirement and it would be nice to have something nice and new for a change.

"There is another thing you could do for me, if you could. As I may have mentioned before, I'm an old man. It is pretty hard for me to work on antennas these days. Antennas are pretty important and all I have are some old dipoles which have taken a beating through the years. If you could arrange to bring me a good, sturdy, tall, tower . . . with separate beams for the HF bands, and maybe something for 40 and 80, well, that would really set me up in fine shape.

"I don't know how much influence you have, Santa, but if it wouldn't be asking too much, I wonder if you could do something to get rid of some of the QRM. It sure isn't like it was in the old days. Heck, years ago, we used to be able to find big empty places on the bands and not be bothered with QRM. Now it seems like every place you want to operate, you don't have a clear spot to call CQ. They began letting everyone in on ham radio and all the old timers are left out in the cold. Let me tell you what I mean.

"A few years back, they decided to make some changes in the licensing laws and put in what they call a Novice Class license. Now, I figure anybody who hasn't got the brains to get a 'real' license, has no business taking up space on the bands. 'Course I haven't worked much CW in a long time (I said my hands weren't too steady now) but they really make a lot of QRM and don't say anything. There isn't a one who can send with a good fist that I can copy. Why should all those kids take up space on the band? I'd sure be a happy man if you could arrange to get the Novices off

62 73 MAGAZINE

the air.

"Then there are the nets. All kinds of nets. Nuts is a better word for them. They take up valuable space on the bands sending out such trash as 'having a good time at the fair. Be home Friday' and stuff like that. They give the excuse that this gives them practice so they can be ready in the case of an emergency. Now, you know as well as I do that you don't need practice to be ready in an emergency. All they do is cause more QRM. If you could do something to free all those traffic nets, it would be the greatest thing ever to happen to ham radio.

"Oh, yes, I nearly forgot. All this non-sense with working DX! That is the most ridiculous thing I ever heard of. If you could just listen in to one of those DX pile-ups, it would make you wonder what was going on. Give me a good old fashioned rag chew every time. But these days it is hard to find anyone to rag-chew with who can talk about the old days. Anyhow, how about stopping all the DXpeditions and getting things back to normal?

"So long as I'm going to go on SSB, and since everyone says AM is obsolete, you might as well clear out all the AM operation too. And, while you are about it, I don't see too much point in keeping CW, either. Seems as if with all the new ideas in radio, there isn't much need to keep up with CW. Just look at all the space they take up that could be used for SSB.

"Well, I guess that about wraps it up no, there is another thing that gets me. How about all this certificate thing? Some hams just spend all day on the air looking for new pieces of wall paper. They don't contribute anything to ham radio. If you could just get rid of them things would be fine. And the whole idea of weekends being taken up with contests is another sore point with me. Why, a fellow gets on the air on a weekend and every contact he makes hands him a number. I just can't figure why all that was started in the first place. Just a bunch of darned fools staying up all night trying to compete. Those weekends are terrible. A man can't find a good contact anymore.

"I guess that is all, Santa. Nope, there is one thing I nearly forgot. Women! The day they gave a ham license to a woman was the worst thing they could have done. All those YLs sould like a bunch of chip-

munks and you can't understand a thing they say. Seems to me they ought to all be in the kitchen tending to business. The best thing you can do for ham radio is to get all those women off the air.

"Well, Santa, I guess this is a pretty big order, but it sure would make an old man happy if you could fix this all up for me.

73,

An Old Timer"

The old timer put down his pen, left his letter in a prominent place and headed out of the shack to his bedroom. Soon he was asleep, dreaming of his new rig and the new world of ham radio. Others may have had visions of sugar plums, but he had visions of QRM-free contacts on his new rig.

Christmas day dawned clear and cold. The old timer awakened slowly. The bed was warm and the room was cold, so he stayed beneath the blanket for a while. Suddenly he remembered his letter of the night before, and, like a child, he sprang out of bed and ran for the ham shack. There his eyes greeted the new world of ham radio. All the racks were gone. The old desk had been replaced by a lovely console with the Gollings X-line. He dashed forward and threw on the filament switches. Wait, . . . how about the antennas? He ran to the window and looked out onto the snowy ground. Sure enough, there was his new tower reaching to the sky. Looking up, he saw beautiful stacked 10-15- and 20-meter beams, along with a rotatable 40 meter dipole and an inverted vee for 80.

In nearly uncontrolled joy, he dashed back to the rig and began tuning 20 meters. From one end of the band to the other, he heard only atmospheric noise at S 1. Switching from 20 to 15 then 10, he found the same conditions. "Must have been a good blackout", he thought, "But, I'll find the old gang on 40". A check on 40 brought the same results. "Well, there will always be the gang on 3999" he muttered as he quickly switched to the other antenna. 3999 had a bit of interference from NSS, but the ham band was silent.

There on the desk was the last page of his letter to Santa. There was a note at the bottom saying, "Dear old timer, I have brought you everything you asked for. I hope you have a Merry Christmas with your new rig". It was signed, "Santa Claus".

. . . WØHJL

The Contest Caper

Sooner or later, the urge to take a crack at a contest hits everyone. Unfortunately, most operators become discouraged and quit seriously contending when they find their final score is substantially lower than the top operator's. The intent of this article is to explore some reasons behind the score difference and to point out some items which hopefully will allow you to make a significant increase in your score or even put you on top.

The big DX contests and the sweepstakes require special preparation and strategies, so while much of the material covered here is applicable, it is not in itself sufficient. Also such contests are rather infrequent. We will confine our attention to the various QSO parties and the special interest contests such as the QCWA and YL-OM parties which occur almost weekly. Besides, the chances of winning these are much greater as the participation is rather limited.

When you start seriously thinking about winning a contest, you must take a critical look at your shack. Contrary to popular opinion, the high power station doesn't always win, even when there is no special multiplier for low power. On the other hand, you aren't going to win many contests with ten watts. Power levels of 75 to 300 watts are usually quite adequate. If a low-power multiplier is given, say for running under 150 watts, by all means use it. With any



The high-power station doesn't always win . . . on the other hand . . .

kind of decent antenna, the points you might lose due to missed QSO's will be more than offset by the additional multiplier.

Transceive operation is nice, but it can turn into a headache unless you have the offset tuning feature. If you have a choice of antenna orientation, aim at the high population density areas. So far nothing has been said about the type of equipment, and with good reason. The type of contest you enter is usually determined by your normal operating habits, that is, if you usually operate SSB, you will probably operate the phone section of a contest. One thing must be mentioned at this point, if you are a phone-only man, forget the contests that don't distinguish between the CW and phone sections. The CW ops will take you to the cleaners just about every time out.

Perhaps the key words on equipment are flexibility and dependability. Flexibility in this context refers to the ability to rapidly switch bands and modes. Dependability rules out haywire setups because a malfunction or blown component usually means defeat. No one can be prepared for every eventuality, but it's always comforting to know you have a spare set of tubes just in case one should quit.

Control systems should also be checked. VOX and break-in are almost mandatory, although many ops get by with one-switch operation, especially if the switch is foot operated. Foot switches are also great for zero beating. If used, they should be movable since you can get mighty tired of sitting in one position.

Keyers cut the CW work to practically nothing and have the added advantage of making your fist smoother and easier to copy. Don't wait until the contest to learn how to use one though.

Needless to say, TVI should be cleared up if nothing more than for your own peace of mind. Your mental attitude plays a large



If you have a choice of antenna orientation, aim at the high population density areas.

role in determining how well you do in a contest. Along this same line, you should try to eliminate those little annoyances that just never seem to get fixed. Such things as knobs that come loose or chattering relays may seem minor, but after a few hours of operation, they tend to wear your nerves a bit thin.

While you are in the shack, it's also a good idea to take a look at the creature comforts. Vital controls should be within easy reach, especially the receiver tuning knob. You may have to prop the receiver up to get the tuning knob at a comfortable height. Ventilation and lighting are also important. You should be able to operate your station for several hours at a time without becoming unduly tired. Also developing little knacks like holding a pencil while using your key save time and effort and eliminate scrambling around on the floor for a pencil that rolled off the table.

So far no big secrets, and in fact, if you are fairly active, your station probably already meets the above criteria. Now we get into some specifics of contest operating. First of all it is necessary to decide if you are really trying to win or just run up a good score. If you are out to win, you have to do some homework. First get the complete rules for the contest. Don't trust what you read in only one magazine in this regard. Sometimes editors reword rules or leave out what they consider unimportant data, thus giving a misleading impression. Check sev-

eral sources, preferably the sponsor of the contest if time allows. Some contests allow the same station to be contacted on different bands or modes for additional points, others don't, thus it is vital to know exactly what the situation is. Become familiar with the rules and the required exchange information. If suggested congregating frequencies are given, don't assume everyone will be within a few kHz of the frequencies. Some fellows still use crystals! If possible, find out the winning scores from previous contests. This will clue you in on how well you have to do to win, and also give you an idea of who your chief competition is likely to be. The results will also indicate what stations you can expect to be active from rare multipliers.

There is no substitute for experience, and this is especially true in contest operating. After operating a particular contest for several years, you develop a mental file of what stations you can expect to work, and on what band at what time. Also you become familiar to them. W9IOP stressed this last point in regard to the sweepstakes and it is just as true in the smaller contests. If the station you are calling recognizes your call, he is more likely to answer you even though several other stations are also calling. Experience also helps you develop the uncanny ability commonly called savvy. It's this ability that allows you to confidently answer a 10 wpm CQ at 25 wpm with the almost definite certainty that the fellow at the other end can copy it perfectly. It also allows you to tune across a band full of stations calling CQ contest, and even though



Keyers cut the CW work; but don't wait until the contest to learn to use one.

you may not have heard a single call, you know which of the stations you have already worked.

Some operators develop complex systems for logging and cross checking, but usually the simplest method is the best. Regular log forms are not too suitable for contests. Notebook filler or a steno pad can be ruled as necessary so that the exchange information can be entered across the page as it is received without a lot of skipping around. Carbon paper can save you recopying the log, but if you aren't careful it can get messy in a hurry. Check-off lists of county or section multipliers are handy in keeping track of how well you are doing. Use of duplicate sheets depends on the contest and your memory. When multiple contacts with the same station are permitted, they are almost vital to prevent passing up a station because you think you have already worked him on that particular band or mode. An atlas and a recent callbook are also extremely useful.

Working stations not actively in the contest can mean the difference between top money and also ran, thus it is necessary to be able to rapidly identify such stations, and especially to determine if they are new multipliers. In this regard most stations will oblige you with a QSO if approached politely. Don't go breaking into nets or QSO's though. It's better to wait a few minutes than risk losing the multiplier. Courtesy is a key factor in contest operating. It doesn't hurt to QRS for the slow op, or to explain what the contest is all about to a newcomer, and if you do it, you just might find you picked up a few extra points along



Some operators develop complex systems for logging and cross checking.



Breaks for chow and sleep are necessary if you are to be in top form.

the way.

If a general strategy could be formulated, it might best be described as: run up a good contact total and then concentrate on multipliers. For instance, if you have 75 QSO's in 30 sections, each additional section is worth more than twice as many points as an additional contact. It gets to be a bit touchy when you have to decide whether to spend a considerable amount of time chasing a new section or pass it by in the hope you can work him when the pileup has thinned out. I prefer to stick with it since conditions may change for the worse or he may QRT. Flipping a coin may help. Most of the time you will be on the chasing end, that is, you will have to find the stations you want to work whether they be stations in Illinois, YL's, or members of QCWA. Thus your time is better spent in tuning the receiver than sitting on one frequency calling CQ contest. CQ wheels and tapes are fine, but don't really help much unless you are the one being chased.

Before sending your log in, double check it to see that it is in the proper form and the score is correctly, and honestly, computed. Duplicated contacts should be left in the log although no points should be claimed for them. If a signed statement of rule observation is required, be sure to include it with the log. Needless to say, the log should be neat and readable. Also make sure it is postmarked before the contest deadline.

Most operators find it impossible to operate a contest straight through. Breaks for chow and sleep are necessary if you are to be in top form. Sleep is a personal matter, but in any event, the period between midnight and seven AM tends to be the slowest. If you have worked most of the active stations, you are fairly safe in knocking off during this period. I won't make any guarantees though.

One habit to develop is that of periodically checking the other bands even though the band you are on is producing contacts. A brief skip opening can produce a wealth of points your opponents never even know exist, and once the band changes, such points are almost impossible to make up. Also many stations tend to operate only one band and they may only be on for short periods, thus to work them you have to meet them on their own ground. A quick check of the novice bands now and then might prove fruitful.

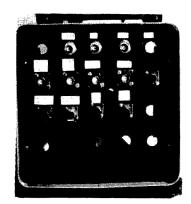
Many operators just don't have the patience it takes to win. Often you will find yourself waiting in line for a QSO, especially if a new multiplier suddenly shows up. But again it's much wiser to wait than risk losing the multiplier. This is probably the best argument for running high power. One of

the greatest frustrations of contest operating is waiting in line while a station passes out S-six and seven reports only to receive an S-nine plus when it finally comes your turn. Perhaps the most discouraging aspect of a contest is hearing a station across the state giving a higher number than yours in the final hours of a test. But remember, he may not submit a log, he may not have as good a multiplier, and finally, he may be lying.

Some operators continually gripe about the number of contests taking place on the bands. Actually most contests are confined to a ten or twenty kHz of the band, and thus don't usually disrupt normal operating in the band to a large extent. But they do provide an effective way for the fellow with limited time to earn awards or just get a good dose of operating. They are also the best way to truly test new equipment and to gain operating proficiency. Contests are more fun if you do well or win. Almost any reasonably equipped station is capable of winning, especially if the operator is on the ball. The points listed in this article are taken for granted by most steady contest operators, but the newcomer has to develop the techniques by trial and error. I hope some of the hints prove useful to you. C U in the next contest.

. . . **K8K**FP

Patch-All



WØPEM's Patch-All

How easy do you change bands? Coax all over the place? Build this simple, cheap *Patch-All*. I started with a small cabinet which was obtained surplus—the front panel is a scrap piece of aluminum.

I have four rows of five coax fittings as shown in the picture. It is not full yet, so I

have room to add more at a later time. I used the one hole BNC coax fittings because they are reasonable to buy and are easy to use. You need to drill only one hole.

The antennas are hooked across the top row. On the second row are antenna relay in, receiver relay in, receiver direct in and transceiver out. The third row has transceiver matchbox in and out and SWR bridge in and out. I have several patch cords about 15-1/2 inches long made up from RG-58/U with male connectors on each end. I also have one that has a regular male coax connector on one end.

There are a lot of different patching possibilities for a person with a little ingenuity. No schematic is shown because every station is different. If you want a very easy and convenient method of changing coax, get out the soldering iron and build one of these handy *Patch-All's*.

... WØPEM

WTW Report

Another month rolls around, the fall of the year is upon us again and it's DX time on the bands. Conditions are very FB I am glad to say. You had better get in there, fellows, and work some of the fine DX that's on the bands every day and night. Don't overlook the chance to get some very small serial numbers yet available, especially on 40. Number 1 is still being held for 75/80 meters as well as 160 meters. Also number 1 certificate is still not issued for 40-meter Phone. Small numbers are still on hand for almost all the bands. Certificate #35 has been issued for 14 MHz phone now so we can really say that small serial numbers are on hand for every band and every mode-when we get up to certificate #100, I will not be able to say small numbers are on hand.

In earning these certificates remember you are, at the same time, "having yourself a ball" working lots of good DX. Remember that WTW has a few more countries than DXCC. Next month we will try to print up a new list of our countries—so pass the word around that all the DX'ers should grab a copy of that issue especially if they are interested in our WTW. It's one issue which everyone should hang on to for reference when working one that you are not sure of.

Remember fellows you can send in your score as per the instructions given in last month's issue of 73 magazine—except it's not necessary for you to send in any cards. Use the multiples we said were acceptable though. We don't want to get one claimed country at a time, and only send in your score for QSO's that you have confirmed. But when you have qualified for the WTW-certificate then you have to submit the cards to your QSL check point. We may ask you to submit QSL's at any time. Remember this in sending in your claimed score for

Honor Roll listings. Everytime any check point sends me the information that so and so has submitted his cards please send me the list of stations that he has confirmed with the dates each one was confirmed. This will help me keep my records better here. We still have plenty of our Country Lists available, either from me (Gus Browning, Rt. #1,



David E. L'Heureux, a Foreign Service Officer of the United States, has recently been licensed to operate in the Central African Republic as TL8DL. He is the only station QRV from TL8 land at present and plans to spend his limited leisure hours at the rig working DX. David still has more than a year left of his tour in the C.A.R. He formerly operated from Libya as 5A4TQ. The TR-3 feeds a TH3-MK2 three element beam about 50 feet above the ground. David operates SSB, usually on the American phone band, and is usually found between 2000 and 2200 hours GMT on either 15 or 20 meters, depending on conditions. He also checks into the YL Net on 14.330 MHz from time to time as #4027.

David prefers to receive QSL's direct addressed to TL8DL, American Embassy, B. P. 924, Bangui, Central African Republic. Stamps not required for his collection will be turned over to missionaries in the country. For direct replies include a S.A.E. and 2 IRC's. Other cards will be distributed via bureaus in Europe and the United States.

Box 161-A, Cordova, S. C. 29039) or you may obtain some from your OSL card check point. If they have none, send me a line and I will send them to you pronto. Remember, send along 25c either in cash or stamps for postage allowance and costs of the large envelope the country lists will be sent in. There are a number of blank spaces for new countries or ones I forgot to include in the list. These country lists are very FB for keeping your country tally and are good for a number of years. I am also using this same country list for my DXers Magazine (weekly deal) Honor Roll so they do you double duty. I talked with Wayne over the phone and he said, "Gus, it's impossible to print up a list without forgetting a few

countries." I told him that the list I was about to print up (used here for my own record keeping purposes only) was 100% complete-I checked it three times, Peggy checked it a few times and two local hams checked it twice each I think-and when it was printed and I started transferring my records to the new list I found that KG6-Guam, and VS6-Hong Kong are missing. Seems as though Wayne knew what he was talking about doesn't it? But one of these days I will print another and not miss any at all except probably W/K for the USA and VE-for Canada. Sometimes the harder you try to be perfect the more mistakes vou make!

. . . W4BPD

Worked the World

14 MHz SSB WTW-200

- 1. Gav Milius W4NIF
- 2. "Hop" Hopple W3DIZ
- 3. Dick Leavitt K3YGI
- 4. Joe Butler K6CAZ

14 MHz SSB WTW-100

- 1. Gav Milius W4NF
- 2. Bob Wagner W5KUC
- 3. "Hop" Hopple W3DJZ
- 4. Bob Gibson W4CCB
- 5. Jim Lawson WA2SFP
- 6. Joe Butler K6CAZ
- 7. Warren Johnson WØNGF
- 8. Lew Papp W3MAC
- 9. George Banta K1SHN
- 10. Dan Redman K8IKB
- 11. Paul Friebertshauser W6YMV
- 12. Jay Chesler W1SEB
- 13. James Edwards W5LOB
- 14. Bill Galloway W4TRG
- 15. Olgierd Weiss WB2NYM
- 16. Jose Toro KP4RK
- 17. Gerald Cunningham W1MMV
- 18. Edward Bauer WA9KQS
- Dick Tesar WA4WIP
- 20. G. "Gus" Brewer W4FPW
- 21. Jack McNutt K9OTB
- 22. Charles R. Sledge W4JVU
- 23. Ira C. Crowder DL5HH
- 24. James Leonard W4FPS
- 26. Gordon Read VE6AKP
- 27. Paul Haczela K2BOO
- 29. Len Malone WA5DAI
- 25. Richard Leavitt K3YGI
- 28. Don B. Search W3AZD 1. Rex G. Trobridge W4BYB

- 30. Egon Gadeberg OZ3SK
- 31. G. Coull ZL3OY
- 32. John F. Berryman K4RZK
- 33. William T. Broder CN8FC
- 34. George C. Blunck WAØOAI
- 35. Bob Parlin WØSFU

14 MHz CW WTW-100

- 1. Vic Ulrich WA2DIG
- 2. James Resler W8EVZ
- 3. Dan Redman K8IKB
- 4. Robert C. Sommer W4CRW
- 5. John Scanlon WB6SHL
- 6. Newton K. Gephart W9HFB
- 7. Fred A. Fisher W5ODI

21 MHz SSB WTW-100

- 1. Ted Marks WA2FQC
- 2. James Lawson WA2SFP
- 3. Joe Hiller W4OPM
- 4. Scott C. Millick K9PPX
- 5. Paul Friebertshauser W6YMV

21 MHz CW WTW-100

1. Joe Hiller W4OPM

28 MHz SSB WTW-100

- 1. James L. Lawson WA2SFP
- 2. Ansel E. Gridley W4GJO
- 3. J. B. Jenkins W5YPX

7 MHz CW WTW-100

2. R. Sigismonti W3WD



Tricky Soldering Job

Now and then, when building a project or wiring a circuit on an aluminum chassis, it becomes necessary to ground a copper wire "at the nearest point". At that point you drill a hole and insert a screw, nut and solder lug to attach the copper wire. Often, due to the presence of a transformer, capacitor or other part on the underside of the chassis, it is not convenient or practical to drill a hole through the chassis. In such a case, why not solder the copper wire to the aluminum chassis?

Most experienced wiremen, proficient with a soldering iron, will tell you that this is impossible. However, if you know why it is impossible, a way can be found to do just that. The author has used the following method on many occasions to make a solid bond between copper and aluminum, using an ordinary soldering iron and ordinary solder (not aluminum solder). And you need no "special tools", just your soldering iron, regular wire solder and a sharp-pointed tool such as an awl, scriber, or other sharppointed instrument. The reason why it is "impossible" to solder on aluminum is that aluminum oxidizes immediately on contact with air. Sandpaper a clean spot on aluminum and before you have lifted the sandpaper the aluminum has already oxidized or "rusted". Therefore, soldering aluminum in a perfect vacuum is as simple as soldering any other metal, but since this is impossible we must find another method of cleaning a spot on aluminum "out of contact with air". Take a piece of scrap aluminum and a few short lengths of copper wire and in a few practice tries you will get the "knack" of it.

It is not necessary to sandpaper or scrape the aluminum to clean it—just wipe the spot with alcohol or any other grease-cutting solvent to remove all traces of oil or grease. If the aluminum feels dry and not oily, the alcohol or solvent is not needed. Place the tip of a hot soldering iron on the spot to be soldered and feed in a few inches of wire-solder to make a puddle of liquid solder.

Keep the tip of the iron in the puddle of solder to keep the puddle liquid and flowing. Using an awl or scriber, scratch deeply in the middle of the puddle of liquid solder. Continue to scratch back and forth and around

in the puddle of liquid solder. Each scratchmark exposes more clean aluminum to which the ordinary solder will bond, because *no air* is present under the puddle of hot, liquid solder. The more you scratch in the puddle, the tighter the bond between solder and aluminum. Remove the soldering iron, and wipe away any excess solder with a rag or old brush. Tin the copper wire to be soldered, and solder it to the "tinned" aluminum just as in any ordinary soldering job, using a fresh piece of solder.

Two or three scratches in the puddle of liquid solder are not sufficient for a good bond. Ten or fifteen scratches in all directions will assure exposure of enough clean aluminum to make a solid, permanent connection between copper wire and an aluminum chassis. A copper-to-aluminum solder joint made in this manner will not corrode or rust, as sometimes happens with the screw-solder-lug-and-nut type of connecting two different metals, because no matter how tight the connection, air is always present and rusting or corrosion can eventually occur.

When the job is finished, test the connection with a strong pull on the copper wire. If the lump of solder pulls loose from the aluminum, the soldering iron was not hot enough to keep the puddle liquid and flowing. The puddle of solder must be kept sufficiently hot and liquid to flow into the scratches on the aluminum, just as solder must be liquid and flowing when soldering any other metal. Slightly more heat is required to keep the puddle liquid, because of the presence of the awl or scriber in the puddle of solder while scratching the aluminum. Scratch deeply into the aluminum surface, since the more aluminum that is exposed in scratching, the tighter the bond. Sufficient heat for the job is a must and a solder connection properly made in this manner is premanent and oxidation-proof.

... W2FFR

More 5Z4's and less VU's

The news from East Africa is good. Amateur licenses are being given out for the first time since Kenya came into its own. Look for a goodly group of 5Z4's around the bands. Quite a need has built up in the last four years.

India reports no new licenses issued for the last ten months. That country has enough trouble without further discouraging the development of electronics trained people.

73 Book Clearance

73 DOOK Clearance
We have a few of these on hand Better Short Wave Reception by Bill Orr \$2.85 \$2.00 New Mobile Handbook by
W6SAI \$2.95\$2.00
One each of these on hand, first come
Industrial Control Circuits \$3.90
ABC's of Radio Navigation \$1.95\$1.00
Citizens Radio Manual Vol. 3. \$2.95\$2.00
Send cash for the above. If they're already sold
we'll send it right back to you. Send to 73, Peterborough, N. H. 03458.
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Solid-State Chopper

To properly adjust the depth of modulation of a TV transmitter, it is necessary to establish a point of zero carrier (see October 1966 73 Magazine). This is usually done by shorting the video input to the scope with a relay pulsed at a 60 Hz rate. Relays used in this way are plagued with point bounce, and changing contact resistance. This results in erratic and jittery scope presentations. Most of these problems can be solved by using relays with mercury wetted contacts, but it's even easier to replace the relay with a cheap transistor. This solid-state chopper will give you a stable presentation with a definite trace for a reference line.

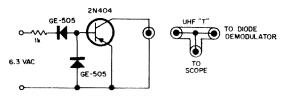
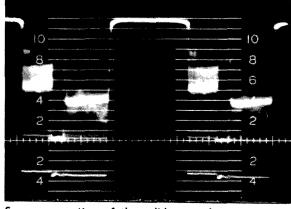


Fig. 1. Schematic of the solid-state chopper.

Any 6.3 Vac source can be used for triggering. I use the calibration voltage from the scope. From this, the diodes form a negative pulse, which drives the transistor into saturation, shorting the scope input, and giving a zero carrier trace for one third of each video frame. Collector to emitter impedance is high, compared to the 75-ohm source, so the chopper will not disturb your video monitor when the 6.3 V is disconnected.

All components were mounted on a piece of perforated phenolic, 1" in diameter. This board is then fastened to a 6/32 x 1%" bolt which has been soldered in the UHF connector to serve as the inner conductor.

. . . John Howard KØMHZ



Scope presention of the solid-state chopper.

Address.....

City_____State____Zip_

WB4DOH: The Piano Prodigy

In writing about Jean Shepard, it's difficult to figure out whether the story should refer to her as one of the youngest female ham radio operators—or as one of North Carolina's most talented, award-winning pianists. The 17 year-old Jacksonville High School senior is both.

Since readers of 73 would be most interested in the young lady's interest in ham radio—let's start there. Her fascination for amateur radio began when she was all of 13 years old. "I used to read books about it. In school at that time, my science project involved electronic equipment."

Shortly afterwards, she built her own set, enough of an accomplishment for an older man, but for a girl just in her teens, it is even more amazing. She put all of the electronic equipment together from scratch and strictly on her own. She constructed her transmitter, the matching circuits, antennaplus all of the etcetera's.

After she got her novice license, she went on the air (operating with the call letters WN4DOH) and began operating from her now-crowded bedroom. To back up just a bit though—it must be said that she does admit to failure. "The first set I constructed didn't work, so I tore it down and built another."

Since that time, she has been operating with a power of 30 watts, but will shortly be increasing her output to 75 or 90. "I'd also like to go on phone," she said. Right now all of her transmission is via code. Most of her current conversation of course, is with people in the immediate area, but she is looking forward to the power increase, introducing her to new friends.

In her home town of Jacksonville, she is secretary of the Onslow Country Radio Club (youngest and only female member). They meet twice a month at the local Red Cross headquarters, "And talk about equipment." Other club members have found out that Jean knows as much about the technical aspects of their rigs as they do. "Sometimes more," one of the men admitted, while talking in admiration of the young piano prodigy.

She became interested in music at the age of ten. Now she is one of the few serious students who has been selected for individual study with Dr. Robert Carter, Professor of Music at East Carolina College in Greenville, North Carolina. He gives private tuition to only three or four students from across the Tarheel State.



Jean not only studies classical piano with Dr. Carter, but devotes about four or five hours a day to practice at home. It has enabled her to become so accomplished that she has received a mark of Superior Plus, at National Guild auditions—involving hundreds of high school and college students from all over North and South Carolina. She was one of very, very few ever to have

achieved such a remarkably high rating.

When not playing at home or for special audiences, Jean travels around the state to perform. She was recently featured at an event sponsored by the Federation of Music Clubs. She has also appeared with the North Carolina Symphony and has given numerous recitals. The young lady would like to be a concert pianist and hopes to enter a conservatory after high school.

Right now, high school almost seems a breeze. Her favorite subjects are physics and math and she maintains a 96.4 average, is a member of the National Honor Society and a Marshall.

While outstanding in such a variety of endeavors as schoolwork, amateur radio and piano—she also enjoys outdoor sports and plays a good game of tennis. "For relaxation, I like to do jigsaw puzzles."

Talent with the unusual seems to be a Shepard family trait. Dad is a research bacteriologist at the Naval Research Laboratory at Camp Lejeune; Julie, a 19 year-old sister, is now studying zoology at North Carolina State University in Raleigh, under a research grant from the National Science Foundation. She is doing research on the Balti-

more Oriole (bird not baseball); a 14 yearold sister, Evelyn, is studying dance at the School of Arts in Winston-Salem, having won top honors in a competitive audition.

The family though is not in competition, one with another. It's just a good, healthy case of each of the youngsters becoming interested in a variety of subjects—encouraged by their parents—and wanting to do their very best.

Jean Shepard has proven that parental concern and a youth's own abilities, can combine to create an outstanding young person.

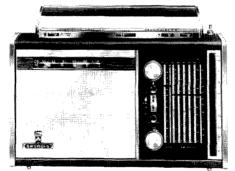
Increasing Resistor Heat Dissipation

To help dissipate the heat in large wirewound resistors in transmitters and power supplies, use the fins from old selenium rectifiers. Break the fins loose from the old selenium units, enlarge the center holes and position them along the body of the resistor. Heat dissipation can be increased slightly by blackening the fins over a flame. Small adjustable cable clamps will hold the fins in their proper positions.

... Richard Mollentine WAØKKC



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Alfred G. Roach

ELECTRONICS

W6JUK

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psst! Go pffft with your Bmmfft!

Do you chuck it all in the garbage-bin after you've read it, or hoard the lot-like most hams-until the shack door refuses to close?

I'm referring to old technical magazines, and W2DXH's article in the May 1966 issue.* His is a very good idea, but to my mind it has two major snags. The first is that one is still left with stacks and stacks of "magcentres," and the second is the difficulty in tracing articles on any one special subject in a hurry, without the time to wade through stacks and stacks of unwanted material.

Ninety percent of all magazine material is pure bmmfft (excepting 73, of course, where 90% is real meat, and only 10% the other stuff). So cut out the genuine gold-neatly, with a single-sided razor-blade-and ditch the rest.

Now, my suggestion is that you file them away under separate headings for each subject-using large cardboard folders. These can be kept in an old cabinet, or even a few hefty boxes.

I started with this system long before WWII, and all was quite simple—to begin with, that is, but like Topsy, it just growed and growed! At first, clippings went under such headings as "Antenna, modulators, transmitters, receivers, etc."

However, as the years went by, these individual files became so over-filled that most had to be sub-divided. For instance, "Antenna" would grow into "Beams, HF, inverted-V, long-wire, VHF, all-band, Quad, towers, rotators, feeders, etc."

The great beauty of this "cutting-up" and "sub-dividing" is that one can lay one's hands on the articles dealing with a specific subject-literally, within seconds! Several times, my phone has rung, and a fellow amateur has asked if I could help him regarding say "Q-fivers" or perhaps "Q-multipliers." Whilst he was hanging on the landline, I would open the filing cabinet, and produce a card-board folder containing practically every article on "Q-fivers" written during the past quarter-century . . .

Can anyone suggest a quicker way of

finding information?

It is rather interesting to go carefully through a file and note how the same particular subject is written up every decade as being "something new," when all the time it is an old idea in new guise. Pre-war, it was first of all battery-operated tubes, and then mains tubes. After 1946 came miniature tubes, and of late, transistors. Then we've had printed circuits and encapsulated unit construction . . . but basically, the same circuitry! Mutton dressed up as lamb, and served as the plat-du-jour.

But I digress. Back to practicalities. One of the greatest difficulties in filing under the "KPO system" is what to do with the kind of magazine which finishes one article on reverse page of another-73 is exemplary in this respect!

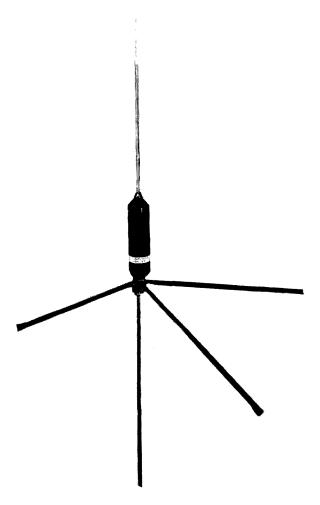
It is, of course, possible to type out (or photo-copy) the meat in the last pageit's funny how much "padding" goes in the last few paragraphs of most articles! But perhaps the easiest way is to file away all opening" pages of articles, and then make a note on the bottom of the page, giving the title of the article on the reverse of which the first article is concluded. Phew-hope that explains itself.

One final word of warning. Never, never lend any of your precious files-you'll never see 'em again. I know, having suffered bitterly. It's bad enough when they keep the whole file, but even worse when they return it minus the very pages you wanted most.

*James Ashe, "Dealing with the Information Explosion," 73, May 1966, page 42.

Waters Band-Adder 370-3

Mobiling with Fingers



Waters Manufacturing, Inc. of Wayland Massachusetts, has finally solved the problems of multiband mobile operation at low cost; and it works. Furthermore, it works remarkable well.

The Band-Adder consists of an assembly of three helically wound resonator

"sticks" in a metal bushing which mounts on the top of the mobile mast, just below either a 40 or 75 meter coil and tip, adding 10, 15, and 20 meter operation to the original antenna.

Having used several makes of center-loaded mobile antennas, I find there is always the problem of stopping the car, getting out the wrenches, and changing the coil and tip. Therefore, I was reluctant to change bands even when conditions on one band would deteriorate. Not so when the *Band-Adder* was installed. I can now change bands without touching the antenna.

Since resonance is controlled for each band primarily by the inductance of the helix for each band, the *Band-Adder* is self selecting without the use of any type of switching device. The *Band-Adder* coils are pre-tuned for full coverage of the 10, 15, and 20 meter bands and will handle 500 watts PEP on SSB and 100 watts on AM.

When the *Band-Adder* is first installed, it will be necessary to retune the 40 or 75 meter tip to resonance due to the added capacitance. This is a slight change, usually shorter.

I must admit to a certain amount of skepticism when the idea was first presented to me. This doubt rapidly disappeared when I began running it through some tests.

I tested the *Band-Adder* with the *Waters Auto-Match* and with two other popular center-loaded mobile antennas with much the same results. The conclusion is that it works equally well with any center-loaded whip which has % - 24 studs.

Using the 75-meter coil and tip, I first adjusted for resonance on 75. This required

Specifications

Frequency Ranges:

28.5 MHz-29.80 MHz 21.2 MHz—21.45 MHz 14.2 MHz—14.35 MHz

Mounting:

Female 3/8-24 thread to attach to standard mast and male 3/8-24 stud to accept standard 40 or 75 meter

Transmission Line:

When used with 75 meter coil tip we recommend your using RG 58/U 50 ohm cable. When used with the Waters 40 meter coil use 35 ohm cable (Waters 370-48).

NOTE: When 35 ohm cable is used the VSWR on 15 meters will be about 2:1.

about a % inch shorting of the tip. This adjustment was at my normal operating frequency which had previously had an SWR of 1:1. I was still able to get the SWR down to 1:1 and, oddly enough, when I got on the air, I was told I had an outstanding signal. This led me to run some field strength tests (with and without the Band-Adder) and discovered a 2 dB gain over the original antenna. This began to look better and better. In field strength tests on the other three bands as compared to the separate coils and tips, I found virtually no difference. On 10 meters, it was equal to the separate coil and tip, on 15, it was down 1 dB, and on 20, it was up 1 dB.

Looking at SWR readings, from 28.1 to 29 MHz (the range of my transceiver) I found the highest SWR to be 2:1, with a much more broadband operation possible than with the 10 meter coil and tip. On 15 the maximum SWR was 2.5:1 at the extreme ends of the phone band with a good 1:1 match in the center. On 20, the maximum SWR was 2:1 with a more limited range which was flat.

The one disadvantage I found was in added wind resistance with high speed driving. This may mean the addition of a nylon cord to support the mast at high speeds. Certainly this is a minor obstacle and a small price to pay for the advantages of band switching.

One other point. If you, for instance, only want to operate 20 and 75, simply remove the 10 and 15 meter "fingers" and it makes no difference. There is no inter-dependency between the three "sticks". You may use one. two, or all three as you wish.

I'm not sure what magic was performed at the Waters factory, but they have provided a new facet to mobile operation with the Band-Adder.

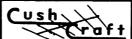
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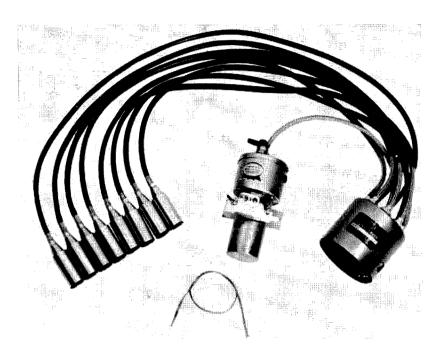
REMEMBER THE 11-METER BAND?

It's active, as you know, if you ever listen in on the Citizens Band. In fact, there are more rigs on the air (some 3-million) in that 300-KHz slot than in any other part of the radio spectrum. And, surprisingly enough, many of the rigs are more sophisticated than many ham rigs.

To keep up with what's going on in the CB world, read CB Magazine, the responsible CB publication which contains articles on theory, the HELP program and all kinds of radio communications including ham.

For a free sample copy, send your request on your QSL card to CB MAGAZINE, P.O. Box 60445, Oklahoma City, OK. 73106.





A. A. Wicks WB6KFI
1208 Levin Avenue
Mountain View, California 94040

The Hallet Signal Saver®

In the past few years, the number of amateur mobile installations has increased at a tremendous rate. This has been accelerated by the availability of transceiver equipment, which is usually compact, presentable, and easily removed for a dual-purpose role of fixed or mobile. If statistics were available, and CB and boat installations were added, the total figure would no doubt be amazing.

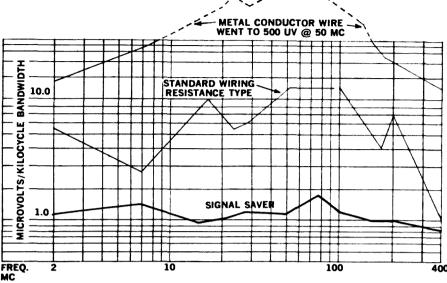
It would probably also be astonishing to know how many users were suffering to a lesser or greater degree from self-created ignition interference. Until recently, I was one of these sufferers, when the Hallett Signal Saver was installed on a new car and tested. Before this, a National NCX-3 had been used in a 1960 Chevrolet, and with no special corrective measures being taken other than the usual capacitors on generator, etc., the ignition (and possible other) noise

level of S2 was tolerated as being "the best that could be done".

Upon acquiring a 1966 Ford Galaxie, and reinstalling all of the equipment, including the antenna, in an identical configuration, it was very disconcerting to note that there was now a steady, solid S7 noise level. This appeared to be all ignition noise, but there was a distinct possibility that this noise was masking alternator and possibly other noise sources.

An inspection of the Ford, carried out with the engineering specifications for noise suppression as supplied by the Ford Motor Company, showed that, with the exception of a "radio resistance" primary lead and one copper hood-bonding spring, no suppressive measures had been taken with this car. The Ford looked like a classical case for the

Measurement of radiation interference (noise level), compares the Hallett Signal Saver and original equipment on an automobile using resistive wiring.



Signal Saver, which was receiving strong promotion at the radio parts suppliers.

Before making the installation, a test was made under existing conditions. An open area, two miles from the nearest power line or other man-made structure, was chosen as a test site. Antenna resonant frequencies of 3900, 7260, and 14,260 kHz were selected, and noise levels checked with engine running and engine off. The latter condition showed an S-meter reading of zero, and with the engine running, the aforementioned noise level of S7 was noted on all frequencies. The noise was so severe that no signal-free check frequency was selected-only strongest local signals were received anyway. The equipment in all tests consisted of a NCX-3, a Webster Topsider antenna and a Linear Systems 350-12 dc power supply. RF gain was set at maximum in this and all subsequent tests. Following this initial test, I proceeded to install the Signal Saver.

The general appearance and sturdy construction of the Signal Saver equipment is excellent. Heavy steel is used throughout, and it is attractively and heavily coated with a gold finish. A chrome finish, if it were available, would probably attract the hotrod set.

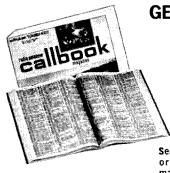
The equipment, as received, was complete for the specified installation. Two systems are available, one for conventional distributor caps, where the original will continue to be used, and one for those caps that are equipped with a timing window. The installation shown in the photo consists of a distributor cap shield, a coil shield, and spark-plug shields with shielded wire securely soldered to the shield, and terminated at the distributor end by a very secure snaplocking cap. The coil shield contains an integral feed-through capacitor to the "hot" ignition switch lead. The shielded cables are made up of aircraft type ignition cable and the braid is protected with a stainless steel conductor. The cable itself has a temperature rating from -65F up to 250F. The complete installation is certified to be dust-proof, spark-proof, and moisture-proof.

Installation was relatively simple. However, California automobile owners may have some "squeeze" problems due to the large amount of smog-control equipment spread over the engines of their cars. This was particularly difficult for the coil installation. This portion of the installation took four hours, of which one hour was spent in removing paint thoroughly from the coil case



Installation of the Hallett Signal Saver on a V-8 engine (air cleaner removed).

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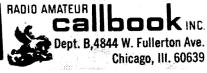
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to provide a good bonding contact. About one hour was used in making a "dry run" to see if we were even going to be able to make it through all the hoses and pumps. Normally, two hours should suffice for this portion, and about another hour for the distributor and spark plug wiring. With one exception all spark plug cable lengths were adequate -the number five plug cable had to be routed in a slightly different manner in order to reach from the distributor to the plug. Once the shields are installed, a metal clamp groups each bank of plug wires together so that the whole installation looks neat, in addition to providing further bonding. Sparkplug shields may be quickly removed without tools for any plug work required.

The instructions are very explicit and appeared to be written with this car in mind. This is probably not the case, but is a compliment to their preparation. Only two very minor inconsistencies were noted. Many clear photographs are used (twelve on two pages, for example), and the line drawings are excellent.

Results of the installation exceeded all expectations. Somehow, we anticipated hearing some noise. Instead, S1 and S2 signals were coming through, and, they were readable! It was somewhat shocking to hear ignition noise from passing cars, but very pleasant to drive along in a rural area away from all power lines, and hear nothing but signals. Actually, the reception appeared to be better than at the fixed location. The same test frequencies were used after the shielded installation was made, but due to signals coming through at levels from S9+ to S1, an additional check was made at 4100, 7350, and 14,533 kHz. Nothing was heard at these particular frequencies, either signals or noise.

The Signal Saver components are available as individual items, or a complete system may be purchased. All parts are ready to install without modification. For unusual situations, such as large marine engines, the company will provide special materials. Radio parts suppliers carry a listing showing the system to be used for any particular car.

The installation of this system can be a boon to amateur, citizen-bander and marine operator alike. The old saying "you can't work them if you can't hear them", is most appropriate in mobile work. With the Signal Saver, you will hear them.

. . . WB6KFI

Gus: Part 30

Back to South Africa

After a brief visit in Capetown with my good friends Jack and Marge (ZSIOU and ZS1RM), I departed for Kroonstad, a fairly good sized city which is between Capetown

and Johannesburg.

I was met at the station by my good friend Syd ZS4RM. I had mentioned to Syd on my first stop at his home some months previously, that I wanted him to put my name on one of those fine peach trees he had in his back yard. Luckily I did, because he had sold all the peaches on all the other trees except this one big, fine one that was loaded with the finest peaches I have ever seen anywhere. Syd and his wife took me out in his backyard and pointing at the tree, said, "they are yours, Gus". I spent some four or five days with them and I think I ate most of the peaches from that tree before I left. They made some very fine peach ice cream with some, made peach cobbler pies with some, many were used by just slicing them, covering them with sugar and then with fresh whipped cream-man thats eating high on the hog. I definitely say in all the world with the fine eating I have sampled here and there nothing can touch fresh peaches and fresh cream when they are put together.

One day Sid drove me over to the town of Welcome in his little car (I think it was a Volkswagon). Syd and the other ZS4 fellows I met while down in Welcome told me about this town. Just a few years before I visited the town, it was just a big, flat field, with very few trees in it, and the land where the town was built was a few very large farms. In some way they found that gold was down below the place and very deep mines were sunk. It turned out that the place was loaded with gold bearing rock at a very deep depth. I took a trip down one of these mines. I forget the exact depth but it was something like 7,500 foot straight down and I had a look see at how things were down there. Even with all the tremendous blowers and even airconditioning in some, it was very warm down at that depth. They hauled the rock up after it was loosened by various means.

At the surface, it was crushed and by some chemical process the gold was removed from the rock. Sitting on a small table, they had one of the gold bricks with a sign that said, "Its yours if you can pick it up with one hand, no sliding to the edge of the table permitted". Of course like many others I grabbed at it and let me tell you, I don't know what it's weight was, but I could not budge it from that table! Its size was somewhat smaller than a usual brick but it must have weighed 50 or so pounds. I sure could have used that "chunk" of gold.

The town of Welcome was laid out absolutely perfectly. Every street was a straight line, and all city blocks were perfectly square. The houses there were all brand new; each one air conditioned, beautiful lawns, and every house had a car in its front yard. The entire place had the smell of real prosperity. Everyone was very well dressed and had a very happy look on their face-it looked like a very fine place to work and live. It was one place that, if I was a young man looking for a place to settle down and live the rest of my life, I would have stayed. Sid and I drove all around the town and visited quite a few houses and hams, many of them real DXers. They all had some very fine rigs and most of them had either quads or vagis for antennas. These fellows all seemed to be making very good money on their jobs.

After spending a full day there, we drove back to Kroonstaad and had a real ball on the air with all the "Gus Watchers," telling them the date I expected to arrive at the next DX QTH. I even connected up my own rig and used it. Sid said it sure was great to be able to operate a real rig! He sure did love the feel of that rig I had and he thought the electronic key was great. It was made especially for me by my friend-W3KVQ/2—good old Ed. I have it in use at my home station now and it's still as good as it ever was. In fact it seems to improve with age!—but back to the story—

Time arrived for me to depart from Sid and those FB peaches. Sid was one of those fellows who went all out to make my stay at his home a highlight, and it was with regrets that I departed for Johannesburg.

I was met at the railway station by Lamberth, ZS6LM, who is just about one of the sharpest operators in ZS land, and a technician of the first magnitude. Lamberth had made all the arrangements for us to drive down to Basutoland (now its called Lesoto) and he had the license in order and all necessary permits fixed up for both of us. Now this fellow Lamberth was one of these thorough Dutchmen (used to be a PAØ, some years before moving to ZS land) and he had the check list all made out of what we were to take with us on this camp out DXpedition into Basutoland. Absolutely nothing was overlooked either, and we were prepared for any eventuality. Plenty of spare parts, plenty of food, a cook stove, canned goods, fresh fruit, plenty of spare Petrol & oil for the putt-putt (power plant) which I had brought back with me from my island stops at ZD9 and LH4 lands. The plant I had used all this time was a 1 KW Onin with shielded spark plug wire and to eliminate the last bit of spark noise, I had installed a 10,000 ohm, ½ watt resistor. This one was a 115 volt job and I could get

up to 4 hours from a gallon of gasoline with it. It used about 1 quart of #20 motor oil to every 30 gallons of gas. I would take the same plant again, I think. I had tried my very best to buy one of these new very small, light weight plants that has magnets and uses no brushes, but I could never get them to, lets call it "play ball" and sell it to me at what I thought a good price. Maybe if there is another trip I will have better luck with them. It would have been very nice to have used a smaller plant and saved lots on "surplus baggage" charges all along the way. Don't ever think, fellows, it's easy traveling all over the world with 3 suit cases full of radio gear and a wooden box with a power plant in it with a very thin pocketbook and not in a good financial position to pass out large tips to the various red caps you need at every stop. And then there were those Customs boys to deal with. This along with sometimes as much as 100 rolls of color 35mm film and two cameras to "explain" to them. After months and months of this, you get to the point where you don't even worry about it any more. I had many different stories to tell the Custom boys usually no two of them were ever the

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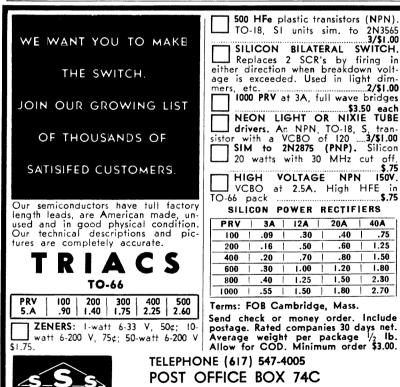
same; and you must remember at some stops, the Custom fellows could not even speak English.

Like I said quite a few lines back, here I was at the home of ZS6LM getting ready to go along with him over into Basutoland (ZS8). We had a small trailer attached to the rear of Lamberth's car. This was a small one and every single item was packed in it. I don't think there was enough room left for a flea to get in. That fellow Lamberth really knew how to pack a trailer. Then a large canvas cover was wrapped around it so that if it rained nothing could get wet.

Lamberth spoke fairly good English and just a little of the South African tongue called Africaans. The further we got away from Johannesburg, the less and less the local people could understand English—but Lamberth said they were just putting this act on, that they could understand and speak English OK but were just hard headed and did not want to use that tongue because their feelings at that time were not too good towards England. The trip from Johannesburg to ZS8 land took us from about 4 AM in the morning to about 5 PM that afternoon. There were good roads all

the way up to the border of ZS8, a very rocky, mountainous looking sort of country. strictly run by their natives, policeman, customs officials and all. At least they spoke and understood English. The last hundred or so miles, no one at any of our stops along the way could understand or speak English, or thats what they indicated to us. This did not make either Lamberth or me very happy. It was very difficult to convey to them that we even wanted a cup of coffee and gasoline for the car.

The customs and immigration stop at the border of ZS8 was very brief and we were treated very nicely. They did not try to cause us any delay at all. We drove thru Maseru some 10 or 15 miles into the country, around a few small hills and mountains, turned off on a side road and found a small lake with a beautiful grassy spot under some high trees, an ideal spot for our operating position. We stopped and got out the car and walked all over the place looking up at the tall FB trees to support our antennas, etc. Then we drove back to Masuru, to hunt up the Government Officials, police dept., security dept, army, etc., to tell them why we were down there and what we wanted to do. In a few hours we were



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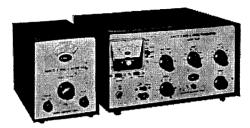


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cleared to operate. We explained to them where we wanted to operate from, telling them exactly where the nice little lakefront was. We found that this was Government property and after locating the right officials we were given permission to stay and operate from that spot. We stopped at a sort of grocery store/bakery and bought a few loaves of bread (hard as a rock and just as heavy too!). Back to our little DXpedition QTH we drove, and by doing a lot of rushing we managed to get our tent erected before nightfall. After nightfall, it was us and the mosquitoes, but when we got our netting over the beds in place the QRM from them ceased. We were dead tired so had no trouble getting to sleep that night. In the distance we could hear a few lions roaring and many other strange sounds eminating from the jungle which was some few miles away from us.

We were up early the next morning and I was raring to get an antenna up and to get on the air! We found the trees impossible to climb, the first limbs on them being out of our reach. But, while we were trying to figure a way to get our antennas up in the tops of the higher ones, two

natives came past, an old man and probably his young son. The old man looked as if he was about 60 and the younger one about 20 years old. Lamberth hailed them and asked them if they could climb these trees. Neither of them could understand. He then tried in his beat-up Africaans language and the old man could sort of halfway understand this, but the youngest one could not! After a little explaining the younger man agreed to climb the trees for us. This was a very interesting antenna installation fellows. I would tell Lamberth, he would translate what I said into Africaan, and give it to the old man, the old man would then translate this into the Basuto tongue. To this day I am quite sure the final message to the fellow up the tree installing the antennas was never the message I gave to Lamberth! Something was lost along the way I am sure. After about 6 or 7 hours of yelling back and forth we finally ended up with my Hy-Gain model 14AVQ vertical up in the very top of the tallest tree some 75 to 80 feet from the ground—a very FB antenna we had there, fellers. Then we put up our 80 meter halfwave dipole between the next two tallest trees, some 70 feet or so above the ground. We were all set for a very

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fine DXpedition operation. The power plant was set up 500 ft. away at the end of two 250 foot extension cords attached together. These two #12 wire extension cords saw me all around the world and came in very handy many times so as to be able to get the power plant a good distance away from the operating position. This was about 3PM in the afternoon, I let Lamberth have the first go at the rig, while I sacked up (I wanted to be well rested for my turn!). Lamberth stayed with it for about 3 hours, turning the rig over to me just about sundown-which we all know is a good time to be on the air from anywhere in the world. With our all band capability some band was open all the time except from about 4 to 5 AM, which I had found was a bad time to try operating from almost any point on the globe. But, right now, I would think many bands would be open all night long with the FB sunspots we now have with us. The sunspots were very close to their minimum 11 year count when I was on this one trip, so I could not depend on much help from ole Sol. But even with the Sun spots against us we had a very fine DXpedition operation from ZS8 land. At that time

Basutoland was on the rare country list and many fellows needed it for a new one. Specially on the lower frequencies. To be honest, fellows-"we had a ball there". Being on a DXpedition with a specialist like Lamberth was a real treat to me. We never had any trouble with both of us wanting to do the operating at the same time. Lamberth was more than fair in our operating schedules-a fine fellow to be with on a DXpedition. It doesn't always work out like this when more than one operator is on a DXpedition, I am sorry to say. The 5 or so days we stayed there passed all too swiftly, but the day to depart always arrives. We had to find the same two fellows who had installed the antennas to take them down. This was no trouble since they lived nearby and like many others around there they were not working anywhere so they were at home and gladly assisted us in the antenna removal. This was a lot easier than erecting them, I am glad to say. Every day while we were down there, we drove to town to pick up something to eat and to get our watertank filled with fresh water. There were plenty of nice oranges, mangos, apauas, grapes, melons there as well as very fine bananas at very cheap prices.

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Canned sardines could be found at the local store at a very high price, I hate to say. We ate plenty of these but not because I liked them, only because that was all to be found in the eating line. Sometimes you try eating just oil sardines and very hard, dry, brittle, stale bread three times a day! Then you will be glad to fill your stomach up with fresh fruit and this is exactly what I did each day. I would estimate I ate about 35 oranges and 25 bananas each day and maybe 3 small sardines and 3 slices of that doggoned bread. I did not look forward to our mealtime I am sorry to say.

We of course drank plenty of coffee, and Lamberth liked it very strong which did not please me at all and there was no instant coffee on this DXpedition. We departed from Basutoland after what I called a very fine operation, I at the moment have forgotten how many stations we actually worked, seems like about 4,700 OSO's as near as I can remember which is not too bad considering the rotten sun-spot activity— BOY it sure would have been great to be there with the bands like they are nowits hard to say how many QSO's a fellow could have if he could stick with it all night long, every night for 5 or 6 nights solid. Maybe one of these days I might get to find out how this would work out—a feller can't ever tell what will happen in the future vou know!

We drove back to Johannesburg, arriving there late that night. The next few days was spent in and around the town visiting the various DXers thereabouts and finding that they all were very well equipped with nice rigs and FB beams mostly. I even got to visit a few gold mines there too, quite interesting these gold mines BUT you can be sure they don't give you any samples of their product. That earth down under Johannesburg must be loaded with gold, I have no idea as to how many Gold mines there are in and around that town. All too soon, time arrived to depart for the east coast city of Durban where the fellows were ORX to have an eve-ball OSO with me. Again it was via train-those fine luxurous trains of South Africa will spoil a fellow. They are as smooth as silk, very quiet, with delicious food at very reasonable prices, too. Much different from the trains in the USA, I hate to say.-more next month fellers.

. . . W4BPD

de W2NSD

never say die

Satellites

When you live almost totally immersed in ham radio, as I do, there is a tendency to keep a crystal ball at hand for occasional checking for portents of the future.

The other day I swung around from a nice chat on 20M with a movie photographer out in Hollywood and looked into the ball. Actually, since those real crystal balls are so expensive. I've made do with the world globe we advertise. I just throw my eyes out of focus a little. I'm thrifty. Well, anyway, there, staring back at me, was another ball. I threw my eyes a little further out of focus, which I find is a lot easier to do these days than it was ten years or so ago, Actually, it is getting harder to keep them in focus now days.

As George Floyd W2RYT/4 would say, "Holy Sacramento!" There was a satellite.

The more I find out about the satellites. the more I am convinced that these are the best thing to come along for amateur radio. Not that we will be using them ourselves in any future that I can see, other than an occasional little Oscar attempt. This would take a national effort and, as far as I know, we have no national society capable of anything creative like that.

When you consider that one single satellite could replace all of the long-lines in our country you can see that it can't be very long before we step into this possible future. The FCC is embroiled in this right now and it is going to get nothing but worse for them. This probably has a lot to do with the almost complete lack of their attention that we got on the ARRL incentive licensing proposition. Obviously they took the easy way out and went along with the pressure from the League. If we don't learn to try to control our own future we are going to be on the dirty end of a lot more sticks.

The FCC is wrestling with the problems posed by CATV. A couple satellites broadcasting television on all channels would put every CATV right out of business. It would also probably put every land-based television station out of business too. There are a lot of commercial interests that can get hurt unless they move now to meet the future

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and find some solution to the coming era. The public has everything to gain. If we have a choice of fifty or one hundred different television channels instead of the present two or three that are available in a great many areas of the country we may get a little more from the slavery to ratings and developed programs for special interest groups. I imagine that we will have a good supply of educational shows. I hope so.

Ma Bell will be able to get all that copper back that she is now using for outside wires to our homes and offices. A small transceiver and a little dish on the roof will enable all phones to be connected via satellite to ground equipment for switching and back to satellite to be relayed. We should be able to have a telephone in our car and even in our shirt pocket, if we want. A unit the size of a pack of cigarettes should enable us to keep in touch with the world. What a thing to have in case of an accident anywhere . . . or even getting lost.

Radio channels would bring us instant news. There might even be different channels for different types of news. Another channel for time and weather announcements, etc. It could do away with watches.

Our great mail problem could be solved via satellite communications. Suppose that a small teleprinter type device were available which would type out the letter and also put it on tape. The tape "letter" could then be sent by satellite and automatically routed to the delivery printer. This should cost even less than our present postage. It would be almost instantaneous and letter exchanges could take place rapidly when desired.

Global television will probably do more to bring the world together than any other influence. The backward peoples will be able to be in contact with what is happening right at the moment all over the world. If the U. S. is first in global television we may well get a head start on teaching English to everyone in the world.

Satellites certainly will be far more efficient for all communications than any system we are using at present. As they come into use we will see those short-wave teleprinter signals disappearing. And they will be followed by the disappearance of short-wave broadcasting. It may not be very many years before we have the short waves all to ourselves again and can expand our bands back to where they were many years ago. Twenty

meters used to run from 14,000 to 15,000 Hz, you know.

Calcutta

Within minutes of my arrival at the hotel in Calcutta VU2RF had located me. This took a bit of doing for I was a day late due to the changed airline schedules from Nepal. I had just time for a quick shower before RF, AJ and HK (VU2's) arrived to take me to dinner. We talked ham talk over the usual Indian curries. They had curried everything, meat, vegetables and potatoes. I think even the peach melba was curried, though it may have been residual. I like curry. Actually, I love curry, but this meal brought on a three day attack of super heartburn that you wouldn't believe. My digestive tract was almost completely destroyed.

My plane to Rangoon was supposed to leave about noon the next day but, having found most of my original reservations on the trip were flights that no longer existed. I checked into the situation upon arrival. Sure enough, my noon flight had been changed to 7:20 AM. And would I please be at the airline office at 5:40 tomorrow morning. I tried to explain to the lady that first of all this was a terrible time to run a flight. And second I wanted to know if the flight out of Rangoon had been changed too so I would be able to stop there. You see Burma is not at all anxious to have any visitors and the very best you can manage is a 24-hour visa. If you arrive in Burma more than 24 hours before your confirmed reservation out of the country they will not let you get off the plane. My flight just flew to Rangoon and then back to Calcutta, so if Royal Thai airlines hadn't changed the schedule out of Rangoon then I couldn't fly in the morning. She knew nothing about this. Royal Thai airlines has no offices in Calcutta so she told me to call SAS airlines, who handle Royal Thai.

SAS informed me that their office was closed and that if I would call after nine in the morning they would let me know about my reservations and the Royal Thai flights. Lady, I'll be on my way to Rangoon by nine. Sorry sir. Oh well, nothing lost but a night's sleep and about two millimeters of ground off teeth.

At five in the morning I groggily checked out of the hotel . . . \$4 for the room with air conditioning and shower . . . and stepped carefully over the people sleeping on the



VU2RF, VU2HK and VU2AJ in Calcutta, three nice fellows who made my visit particularly memorable.

sidewalk into a cab. The taxi fare to the airline office was 10¢, including tip. I reported in to Indian Airlines and found that my plane had been delayed until noon. Well that was good news. Back on the original schedule. I checked and found that my Royal Thai flight was still on schedule and that I would be able to visit Burma.

I went back to the hotel and slept a couple more hours before venturing out for some pictures and sightseeing. By then the thousands of people that I had seen sleeping on the streets were all up and away. A shoeshine man started following me, ignoring the obvious fact that my shoes had been perfectly shined by the hotel boy a few minutes earlier. He kept after me, whining, for several blocks, making my life miserable.

Calcutta is one of the few places in the world left where there are still large numbers of gin rickshaws in use. People . . . people . . . by the tens of thousands. What can I describe? The dried leaves they use instead of small paper bags for candy or cakes . . . the cobbler shops that are just a few square feet of the sidewalk . . . people washing at sidewalk pumps . . .the piece of rope tied to a lamp pole in front of a tobacco shop, lit on one end for customers to light their cigarettes . . . the little booths of the betel nut venders sitting at waist height with the leaves and evil-looking makings spread around them, the booths only about two feet deep.

In checking out of the hotel the second time the manager apologized for the airline letting me get up at five like that. He explained that the flight crew was stopping at the hotel too and that they had been told the night before that the flight was delayed and thus didn't have to get up at the crack of doom. That little bit of news would have saved me a sleepless night of worry.

There was another American on the bus to the airport with me. He was also going to Rangoon, Good deal, it was a lot more fun to have someone to talk things over with. At the airport Indian Airlines checked my visa carefully and rechecked the Royal Thai flight to make sure that they wouldn't get me down to Rangoon and then have to bring me back again. All ok. They explained that this was very unusual for normally, when their flight is on time, there are no flights out of Rangoon within 24 hours, so no one is able to go there to visit. It is only when a plane is very late that a connection can be made. They checked the visa of the other American and had some doubts about it. He tried to get the Burmese Consul on the phone, but coudn't manage it. He finally gave up and went back to Calcutta.

My plane left with just three passengers in the 60 seat plane, and two of us were Burmese. Lunch was served . . . small cardboard box with little waxed paper packages in it. There was a chicken leg, a curried croquet . . . I needed some curry about now . . . carrots and beans, fried potato, roll and butter. and for dessert a macaroon cake and banana. Orange squash to drink. I ate sparingly, remembering the interesting dinner I had had last night with RF, AJ, and HK. I'd give you their names, but Indians seem to go by their last names instead of their first names and it is easier to say RF than Rengarajan. You know, ham talk is ham talk anywhere . . . beams, rigs, DX, new circuits, expeditions, all that stuff. Put me with hams and I'll go on for days telling about the rare ones I used to work with my little Twin-Three beam . . . how many kilowatts some of the louder of the U. S. DX'ers are using, and such.

I did want to tell you about my fascinating visit to Burma this month, but I want to tell you all about that in detail, so I'll hold off and let you have the news next month. Perhaps you've noticed that you have heard absolutely nothing about what is going on in Burma in any magazine or newspaper. The fact of it is that Americans find it almost impossible to get into the country. I doubt if a newsman has been there in years. I read a lot . . . a very lot . . . and I've seen absolutely nothing about the situation there.

... W2NSD

WHY A NEW QUAD?

There are many desirable commercial quad designs available today. If you have ever considered a new antenna and debated the beam versus quad theory, you are undoubtedly aware of advantages of quads and their disadvantages as well. Our Reginair 321 Quad (3 bands, 2 elements, 1 feed line), announced in September, brings to Quad owners several new advantages. Before describing these, let me point out that a good quad should be quickly assembled and erected, without the tedious problem of adjusting stubs, traps, or baluns, and that when completed it should be mechanically rugged and stable for years of trouble free operation. Up to now the beam always led this argument. But no longer.

Imagine, if you will, a quad that will go together in one hour, that requires no tuning or adjustment of any kind, and that will present a flat response of less than 1:5 to 1 over the entire 10, 15, and 20 meter bands with one 52 ohm feed line! Remember too that there is positively no interaction between bands. When you operate on 20 there is no harmonic suck out from the 10 meter element.

Imagine a boomless quad-much less wind resistant, yet mechanically more reliable!

And now for the Reginair's philosophy. To achieve single feed line this Quad is designed so that the *electrical spacing* between driven element and reflector is the same on each band; a reality because of the unique boomless hub. The actual feed impedance of each element is 100 ohms. This is transformed to 50 ohms by a Q section of RG11/U cut for 21 mc. When matching

only 2 to 1 the section works well over the octave from 14 to 28.

The problem of harmonic radiation from the 20 meter element was resolved by inserting a % wave, 10 meter, shorted decoupling stub within the 20 meter driven element at the point of feed. The stub is made of RG8/U, the center conductor of which becomes part of the antenna loop.

The boomless hub is actually a 3½" thick wall aluminum tube, 8" long, machined in such a way as to serve as the anchorage for both the masting and the aluminum tubing which in turn holds the hardwood dowels in place.

The major specifications are:

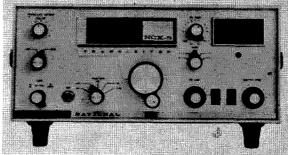
- 1. Full band coverage on 10, 15, and 20 with less than 1:5 VSWR
- 2. Maximum of 4.5 square feet wind resistance
- 3. Turning radius is 9½ feet
- 4. Front to back ratio, 25 db across each band
- 5. Forward gain, 8½ db
- 6. Net weight, 35 lbs; gross shipping weight, 60 lbs.
- 7. Feed impedance, 52 ohms (RG8)
- 8. Power limitation, 2 kw PEP
- 9. Net price F.O.B. Harvard, Mass., \$69.95

Here is a unique new Quad, pre-eminent in design, that not only works well, but will last and last, and yet can be installed in minimum time and with no tune up. Remember, there is nothing you can spend money on that will produce such dynamic change as a good antenna. Put up your Quad now while DX is so good!

HERBERT W. GORDON COMPANY

Woodchuck Hill Road Harvard, Massachusetts 01451 "Helping Hams to Help Themselves"

AN UNUSUAL OFFER



Hams visiting me are invariably impressed when I demonstrate my station. It consists of a National NCX-5 with a BTI Linear. The results are pure pleasure. Just about every station called is worked—no matter where they are located. Obviously my antenna system has a great deal to do with my results, but whereas I have a choice of all transceivers, why do I use the National NCX-5?

In a few words—because I like its performance, and its conveniently thought-out controls. Greater flexibility and ease of operation, especially in contents or when the going gets rough.

When your signal is the dominant one, and when the DX is vying with each other to try to work you, they haven't the time and sometimes the means to exactly zero beat you. Maybe they are only 100 cycles away or perhaps its 2 Kc from where you are transmitting. With most transceivers you would be lost as far as these contacts are concerned, for you wouldn't want to constantly change your transmitted frequency. The NCX-5 has incremental tuning which permits up to plus or minus 5 KC of vernier tuning.

Next in importance to me is the ability to read frequency precisely and to an order of 100 cycles. In most products you only guess at up to ± 3 KC.

Did you ever handle traffic? Notice how often it is necessary to go on the opposite

sideband for copy while the Net continues along. The NCX-5 provides opposite sideband operation.

For Round-table SSB work Vox is most useful. Does your transceiver offer Vox? The National NCX-5 does—and it is a darned good one, too.

Suppose you want to operate CW. Do you have to switch your transceiver every time you listen or every time you send. The National NCX-5 offers automatic break-in CW. To my knowledge, it is the only set that does this.

I could go on and on. Suffice for me to say that this model set has been debugged, is very, very practical for me to use—and should therefore be for you, too.

Now, here is the deal. I will sell you the latest Mark II version—factory fresh NCX-5, at \$549.00. Its matching console speaker and supply is \$110.00. A companion VFO with the same digital read-out sells for \$250.00. Add these up—they total 909 bucks. My special price for the three pieces—all with a 1 year guarantee—is but \$750.00, delivered free to the 48 states. The bargain applies to all three pieces; in effect, you are saving \$150.00 on the companion VFO.

Here is the height of deluxe ham radio operation, at a price you can afford. Terms to those deserving them—trade-ins, too.

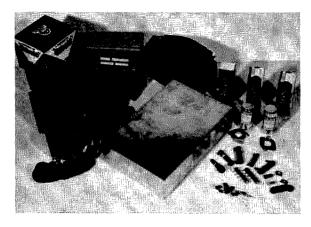
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MEAT AND POTATOES AND SOMETHING CALLED VALUE

I am always on the lookout for electronic components or assemblies which possess potential ham value. I have also been interested in any item which makes it possible for more hams to enjoy sideband. You can, therefore, understand how happy I was when on a recent western trip I found one lot of 225 watt core power transformers and in another area a batch of computer grade electrolytic condensers. Immediately, I felt that we could put out a darned good universal transceiver power supply and when I got back, the boys in the shop confirmed this.

I say universal because with two of these power transformers and two 500 mil chokes, 12 diodes, assorted resistors and other components, we were able to make up a supply which met the requirements of the latest Swan, Collins, Drake, Hallicrafters, Heath, and National transceivers. Talk about value! We can offer this complete assortment of parts including a 16 gauge steel chassis and bottom plate, a good PM speaker and mating plugs for your particular transceiver for just \$50. The transformers in this set weigh 17 lbs. and altogether the completed supply will weigh close to 40 lbs. This is what I call meat and potatoes. The filtering is excellent; the regulation is extremely good, and we have schematics and a printed story to be supplied with each kit, giving detailed infor-



mation as to how to make the connections for your own rig. You will have to tell us what model you own.

This is what the power supply will do: 800-1000 V at up to 400 mils on peak 285-320 V at up to 300 mils bias of up to 125V at 100 mils 12V DC at 1 ampere 12.6V AC at 6.5 amps

Remember, this is an assembly of parts. We do not furnish a drilled chassis; we do not furnish the hardware; we do not furnish the solder and the wire but literally everything else is supplied.

Please allow for 45 lbs. shipping weight or otherwise be prepared to accept Railway Express or motor truck shipment.



AMERICAN BEAUTY 3138 100 watt SOLDERING IRON - \$4.95

This famous iron has been standard in our trade for over 25 years. It will operate year in and year out without failure for it is built like the proverbial battleship. Especially well balanced for heavy use. Heavy enough to solder a chassis and light enough for all general work. The soldering tip is iron plated which greatly reduces pitting and redressing and saves you time if you work with an iron all day long. The casing and body are of one-piece seamless steel. The shatter-proof wooden handle is coated with a durable rubberoid for personal handling comfort. Has a cooling baffle; uses an extra-flexible cord which withstands repeated kinking, and bending. Supplied with tip and stand. One of the most useful and best values I have ever offered. Absolutely new. \$12.50 value—my net is \$4.95. Allow postage for 2½ lbs. Only 275 available.

OF NUTS AND BOLTS

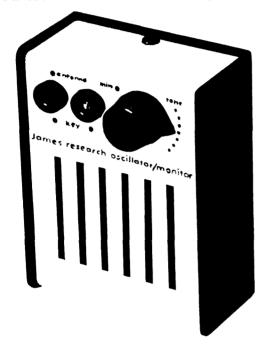
We have 500 boxes of %" 6-32 thread nuts and bolts for \$1.95 a box. These are heavily plated steel oval head bolts with square nuts to match. Used all the time in ham construction projects. Each box weighs 3 lbs. Please allow for postage.

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James Research Oscillator/Monitor



This unit can be used for many purposes. It is a broadband detector, coupled to a dc amplifier which triggers an audible tone oscillator and speaker for use as a DC oscillator/monitor. It will detect any rf power source of as little as 10 milliwatts without direct connection to the unit. The input detector will respond to any frequency between 100 kHz and 1000 MHz and a stiff wire pickup antenna of 8 inches in length is all that is required for most rf detection uses.

As a CW monitor the unit will work with any amateur transmitter and will provide a clean clear CW sidetone. As a code practice oscillator, the unit is self contained, has adjustable tone, and will work with any key, bug, or automatic keyer unit. As a general purpose rf detector, the unit will trigger either by direct connection to low level sources, or by proximity to higher level rf (10 milliwatts or higher).

As a circuit continuity or component tester, the unit will trigger from circuit resistances as high as 100 K with no damage to delicate components. As a semiconductor tester the unit will indicate polarity, type (germanium or silicon) and indicate whether good or bad.

Available from the factory for \$12.95 including battery, postage and insurance. Write The James Research Company, 1111 Schermerhorn Street, Brooklyn, New York 11201.

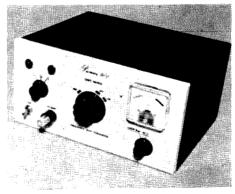
Injectorall Alignment Tool Kit

Not only the presence of metal, but even nearness of fingers to high-frequency transformers can add enough body capacitance to make alignment inaccurate. The use of poorly designed alignment tools can make sweep response curves on a scope misleading. The Injectorall kit contains six alignment tools, all made of nylon which will flex without breaking.

It contains two double ended .100" hex wrenches, 5 and 11 inches long for standard if transformers and coils; a 5 inch long alignment tool with both hex and screwdriver tips; a pair of tuner alignment tools, 7 and 12 inches long; and a double ended .075" hex wrench, 5 inches long for miniature transformers and coils. The kit costs \$1.95 and should be an invaluable addition to any ham shack.

Get them at your local electronics parts distributor or write to the manufacturer, Injectorall Electronics Corporation, Great Neck, New York, 11024.

Pioneer 900



The Pioneer 900 is a tunable frequency shift converter which will accommodate any shift from 100 to 900 Hz. It has continuous tuning of shift range, permitting reception of stations using non-standard shift. The unit is completely solid state with 20 semiconductors and one integrated circuit. This

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Dakota Oity, Nebr.

unit uses a high-voltage keyer stage which will switch up to 300 volts. This high-voltage feature allows a full printing range to be obtained. The Pioneer 900 has a built-in bandpass filter, 250 Hz @ 6 dB selectivity per channel, complete metering, and consumes less than 10 watts. The input impedance is 4 ohms (others on request). The converter is normally packaged in a 5% inch high, 11% inch wide, 6% inch deep cabinet which is perforated. It is also available for rack mounting at a small additional cost. Price for the Amateur model is \$189.50. For further information write Pioneer Elec-

California 93401.

Twintron AF Resonator

tronics, 738 Pacific Street, San Luis Obispo,



Here's a new device for electronics experimenters and builders of radio controls for model aircrafts and boats. It is a tunable, low-cost, electromechanical resonator, called the Twintron. The Twintron can be used in audio oscillator circuits, as a narrow band reject or pass filter and as a tone echo reflector.

This tiny resonator is inherently immune to shock, vibration and mounting position, and is insensitive to harmonics. It is available in three types for the following frequency ranges: 100-700 Hz, 300-3000 Hz, and 700-800 Hz. Each type is tunable to any frequency within it's range, where it will stay until retuned.

Experimenters can use these tunable Twintron resonators in electronic organ oscillator circuits, frequency-sensing devices, CB tone squelch encoders and decoders, fixed-frequency audio oscillators, as extremely selective band-stop and band-pass filters and in radio or wire remote controls. Specifications, application information and prices may be obtained by writing to HB Engineering Corporation, 1101 Ripley Street, Silver Spring, Maryland 20910.



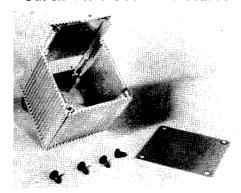
& Broadway

* Made in USA - Model XT-1A, series c

104

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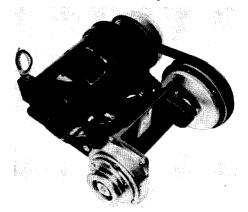
Sarex Mini-Cool Enclosures



The Mini-Cool has literally hundreds of uses for radio amateurs, or anyone who wants to install or mount precision instruments with maximum protection and flexibility. These minature units are constructed to contain cable junction plug boxes, control modules, transformers, circuitry, solid-state devices, meters, and amateur radio gear. Easy drilling, testing, and assembly of components and servicing of circuitry is made possible by the six flat sides of the Mini-Cool, made of lightweight extruded aircraft aluminum alloy. A special feature is a clever lock joint at each corner, which tightens when the screw fasteners are installed.

At present twenty-one sizes are available ranging from $2 \times 2 \times 1\frac{1}{2}$ to $2.6 \times 2.6 \times 10$ inches and are available from your local electronics distributors.

Prosser Constant Output Alternator

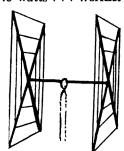


A portable alternator capable of delivering a constant power output of 2500 watts @ 115 volts, with a frequency variation of only ±2.5 Hz has been announced by Prosser Industries, Inc. The model 2511A features an automatic transmission which compensates for input speed changes through 1800-3600 rpm to maintain a constant output of



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UBICAL QUAD AN-TENNAS_ -these two element beams have full wavelength driv tuli wavelength driven element and a reflector; the gain is equal to that of a three element beam and the directivity appears to us to be exceptional! ALL METAL (except the insulators)—absolutely no hambes. Complete with bamboo. Complete with boom, aluminum alloy spreaders; sturdy, universal-type beam mount; uses single 52 ohm coaxial feed; no stubs



uses single 52 ohm coaxial feed; no stubs or matching devices needed; full instruction for the simple one-man assembly and installation are included; this is a fool-proof beam that always works with exceptional results. The cubical quad is the antenna used by the DX champs, and it will do a wonderful job for you! Remember: These are absolutely complete! 10-15-20 CUBICAL QUAD\$35.00

10-15 CUBICAL QUAD 30.00 15-20 CUBICAL QUAD 32.00

BEAMS: new complete with boom and hardware; SWR 1:1; handles 5 KW; adjustable entire band; %" and i" alum, alloy tubing; single coaxial feedline:

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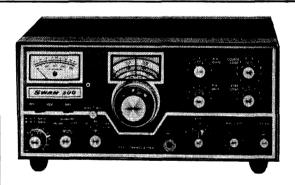
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Closed circuit TV is recognized as a definite necessity for many businesses to combat rising costs. Thousands of factories, office buildings, banks and schools will welcome your demonstration.

Using our list of applications as a guide you will be able to show how any establishment can use several cameras and how each one can save thousands of dollars through the resulting increase in efficiency and security. If you are over 21, have a working knowledge of TV and are financially responsible, we need you as a sales engineer to demonstrate our Model 501 in your area. To receive your application and additional details, send us a resume of yourself and include a self-addressed, stamped envelope.

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ACCESSORIES:

Full Coverage External VFO. Model 410	95
Miniature Phone Band VFO. Model 406B	
Crystal Controlled Mars Oscillator, Model 405X	45
Dual VFO Adaptor. Model 22	25
12 Volt DC Supply, for mobile operation. Model 14-117	
Matching AC Supply. Model 117XC	95
Plug-in VOX Unit. Model VX-1	35



266 ALAMITOS AVENUE LONG BEACH, CALIF. 90802

3600 rpm when the alternator is under load. This feature makes it ideal for CW, RTTY, facsimile, and SSB. Since the clutch functions only when power is required, belt and bearing wear is minimized.

Dimensions of the constant output alternator, including the clutch housing, is only 17 x 17 x 8 inches; weight is 80 pounds. Excitation requirement is either 12 or 24 volts, making the alternator ideal for mobile use, or as a portable power plant when driven by an external engine. For additional information about the Model 2511A, write Prosser Industries, Inc., 900 East Bell Road, Anaheim, California.

Vector D. I. P. Plugbord

These plug-in circuit boards are 4½ Q 6½ inches, with an overall pre-punched grid of .041 holes on 0.1 inch centers, and have copper etched lines .070 inches wide running vertically on one side of the boards and horizontally on the other side.

These new D.I.P. Plugbords provide an easy, fast method of mounting integrated circuits for experimental, prototype, or ham equipment. To speed circuit construction, a line of accessories are available which include line-cutter tools which interrupt the copper lines, printed transparent layout sheets for planning circuit connections, and miniature push-in terminal pins for connection points.

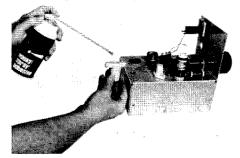
The board material is epoxy paper with two ounce copper etched patterns. Vector also supplies mating receptacles. Other accessories are available such as dual-in-line 14-pin sockets, with or without wire wrap contacts, for direct installation in board and terminals.

Boards may be ordered direct from the factory or through the firm's authorized distributors. Vector Electronic Co., Inc., 1100 Flower St., Glendale, California 91201.

Transceiver Auto-Mount

A simple, inexpensive auto-mount allows you to carry your transceiver in your car, safely belted in with operating controls within easy reach at knee height. It utilizes waste floor space over the drive shaft hump and is easy to install or remove. The Transceiver Auto-Mount retails for \$7.95 postpaid. Satisfaction guaranteed or your money back. If you have any further questions, write to Arco Mfg. Co., Box 817, Grand Forks, North Dakota 58201.

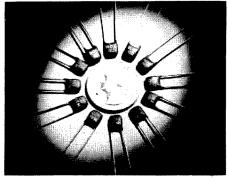
Leal-Lok Epoxy Spray



Leal-Lok is a one part material, supplied in 6-ounce aerosol cans, ready for immediate use. It is as easy to use as rubber cement and as strong as regular epoxy adhesives. It has a multitude of uses for such applications as fastening of brackets, handles, hardware, small parts and components as well as name plates and decorative accessories to panels, chassis, cabinets, and enclosures.

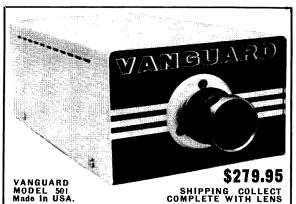
Resulting bonds have lap shear strength from 2000 to 4000 PSI. This material is activated after spraying from the can by contact with air. The initial "grab" of Leal-Lok eliminates the need for clamps and fixtures for most applications. Curing takes 8 to 16 hours to develop full joint strength. Literature and prices on this product are available from Leal Company, Box 53, Oaklyn, New Iersey 08107.

Cornell-Dubilier TMD5 and TMD6



A smaller ceramic capacitor, with high stability, closer tolerance, and a higher capacitance per unit volume., than any previously designed is now available from Cornell-Dubilier Electronics.

Types TMD5 and TMD6, phenolic coated with radial lead construction were designed to meet the requirements of rugged handling experienced under conventional assembly methods. These stable units are ideally suited for conventional or printed wiring



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6012	50U-200U	500	14.95
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6021	75U-300B	2 KW	15. 9 5
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All Units are Rated at Full Power from 2-32 mc Complete with Hardware & Mating Connector

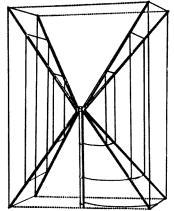
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Standard ratings are available from 10 pF to a new high of 100,000 pF. Type TMD5 and TMD6 dipped ceramic capacitors are manufactured at the CDE "clean-room" facility at Norwood, Massachusetts, under carefully monitored and exacting quality control standards for highest reliability.

For more information contact Marketing Services Department Cornell-Dubilier Electronics, 50 Paris Street, Newark, New Jersey 07101.

Epoxy-Dipped Low-Cost Tantalum Capacitors

JFD Electronics Company Components Division is now offering a broad line of epoxy protected solid tantalum capacitors at a price below that of metal-cased types. These miniature, bead-type units, offer better performance, take up much less space and give considerable overall savings in circuit size relative to aluminum foil electrolytics.

The JFD "Stangard" capacitor series is made of sintered tantalum with a tantalum pentoxide dielectric. Capacitance values are available in ranges from 0.1 to 50 mfd with a tolerance of -20% to 50%. Physically, these units range from 0.2 to 0.28 inches in diameter by 0.3 to 0.38 inches in length.

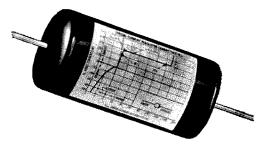
Write to JFD Electronics Company, Components Division, 15th Avenue at 62nd Street, Brooklyn, New York 11219, for the name of your nearest distributor.

Caslon Digital Clock Movement

The ROPAT company wishes to announce the availability of the Caslon Digital Clock Movement. The Caslon utilizes a unique split card read-out feature, combined with a silent, completely enclosed gear box designed for many years of trouble free operation. The movement is available with pilot light and for operation on either 110 or 220 Vac; 50 and 60 Hz operation is provided and all electrical parts are U.L. approved.

This movement makes an excellent addition to TV, radio, transmitters, and any equipment utilizing a built-in clock. For further information contact ROPAT Company, 5557 Centinella Blvd., Los Angeles 66, California.

Motorola Field-Effect Current Regulating Diodes



A new series of current regulating diodes covering the current range from 0.22 to 4.7 mA with 32 devices is now available from Motorola Semiconductor Products, Inc.

The 1N5283 through 1N5314 current regulators are field-effect diodes which establish a constant current flow independent of voltage—the analog of a zener diode which provides a voltage independent of current.

These diodes are well adapted for use as a constant current source in differential amplifier circuits, ramp generators, transistor biasing, or as an active, high impedance load for high voltage-gain amplifiers.

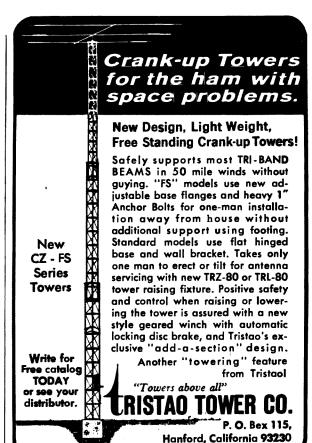
The device current specifications have a $\pm 10\%$ tolerance, a peak operating voltage of 100 volts, 600 mW power dissipation, and is in an hermetically sealed DO-7 glass package.

Further information and complete specifications are available from the Technical Information Center, Motorola Semiconductor Products Inc., Box 13408, Phoenix, Arizona 85002.

World's Smallest Cup Core

The world's smallest ferrite cup core has been developed by Indiana General Corp., Electronics Div., Keasbey, N. J. Its O.D. is 0.125 inches, ground to a 0.035 inch thickness. The main application will be in portable and vehicular communications where size reduction is a prime concern. Its small size allows the cup core to be used in integrated circuits of frequency synthesizers and if sections as radio frequency chokes and transformers.

Core material is IGC's Ferramic® Q2 ferrite which was chosen because of its good frequency response in the 10-65 MHz range and its relatively flat temperature coefficient range from -55°C to +125°C. In addition, Q2 has one of the highest Curie tempera-



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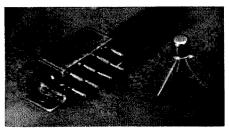
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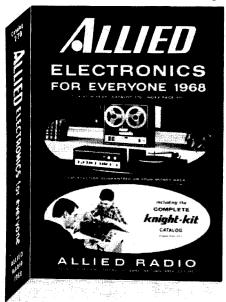
We should give fair warning to those who order this new book from the Radio Society of Great Britain. Once you pick it up, you won't be able to eat, sleep, talk or watch TV until you've read it all. It's a fascinating, densely-packed, 100page book full of every imaginable practical circuit for ham radio. Hundreds of circuits and ideas are discussed, and each one is useful to hams. Here are the chapters: semiconductors, components and construction, receiver topics, oscillators, transmitter topics, audio and modulation, power supplies, aerials and electrical interference, troubleshooting and test equipment. Once you've digested this book thoroughly, you won't be able to build or modify any gear without consulting it.

Technical Topics for the Radio Amateur by Pat Hawker G3VA

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Allied Radio 1968 Catalog



Allied's 1968 catalog lists thousands of products produced by hundreds of manufacturers. Listings include a wide variety of amateur equipment, kits, hi-fi components, CB equipment and accessories, public address and intercom equipment, test instruments, electronic test units and accessories for automobiles and motorcycles, small-screen television sets, radios and phonographs, weather instruments, semiconductors, antennas and accessorie, resistor, capacitors, transformers, relays and timers, switches, plugs and jacks, connectors, sockets, lamps, wire and cable, hardware and technical books.

The 1968 catalog 270 is available free on request from Allied Radio Corp., 100 N. Western Ave., Chicago, Illinois 60680.

101 More Ways to Use Your **VOM and VTVM**

Almost every amateur has a VOM or VTVM on his bench and this new book by Robert Middleton describes 101 ways to use them. These applications include many special uses that haven't previously appeared in print. There are chapters on testing household devices, test-equipment checks, circuit tests, component tests and special uses. Some of the more interesting tests described are determining input capacitance, checking oscillator calibration, measuring impedances of L- and T-pads, checking grid drive, measuring feedthrough in a neutralized rf amplifier, measuring the negative resistance of a semiconductor diode, ohmmeter tests for

transistors and checking zener diodes. If you have a measurement that you can't find a way to make, it might be in this book. \$2.95 from your electronic distributor, or write to Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, Indiana 46206.

Mahlon Loomis Inventor of Radio

This biography, written by Thomas Appleby, is the delightful story of one of the forgotten men of radio. Loomis, a dentist in Washington, D. C., actually communicated by radio over a distance of about 18 miles in 1866! He duplicated his feat several times, and even formed a corporation, the Loomis Wireless Telegraph Company, in 1873. But, he was years ahead of his time. This, coupled with many financial reverses, prevented the company from getting on its feet.

The author has gone through a lot of research and the book reflects his work; it is well written and full of illustrations, many by Dr. Loomis himself. Limited edition \$3.25 postpaid from Loomis Publications, P. O. Box 6318, Washington, D. C. 20015.

Ham's Spanish-English Manual

If you work many Latin-speaking countries in the course of your operating, here is a book that is a real aid. Written jointly by August Gabriel K4BZY and Juan Johannessen LU7FAG, it covers all phases of Spanish conversation used in amateur radio communication. It covers the normal types of conversation used in the course of a QSO plus Spanish phonetics, numbers, and alphabet. It also covers names and nicknames, nouns, verbs and a general vocabulary. According to the authors, with this manual and an additional study of the Spanish language, you can become proficient in speaking Spanish. All in all, a very useful manual for the DXer. Order from August Gabriel K4BZY, 1329 N. E. 4th Avenue, Fort Lauderdale, Florida 33304.

MF/HF Communications Antennas

The price of this excellent antenna book, reviewed in the September 1967 issue of 73 has been increased to \$3.75. For your copy, order DCAG 330-175-1, Addendum No. 1, Engineering Installation Standards Manual, MF/HF Communications Antennas from the Superintendent of Documents, Government Printing Office, Washington, D. C., 20402.

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Letters

Incentive Licensing

Dear 73,

... All the incentive tripe in the world will not change human nature, especially ham nature. I could write a book on violations, bum signals, bad manners, and appliance operators, but why bother you

Now that FCC agrees with incentive, and has assigned frequencies for advance and extra operators, we will see how these 4710 extras stick to their places. And, we will see how many are caught with a foot switch.

Martin Hellman K2TAJ Staten Island, New York

Dear 73.

I have been a General Class ham for more than ten years, and have worked all bands from 160 to 2 meters. Now after all that time, it seems very unfair to me to have almost one half of my operating frequencies taken away. I cannot see how the new licensing proposals will benefit me or anyone else. It will not take any more skill to tune up on 14.205 next year than it does now.

John V. Smith W4ACG St. Petersburg, Florida

Dear 73.

I'm too new to know much about the pros and cons of Incentive licensing, but it looks like it is not all bad. It seems to me that it is going to give Novice ops an opportunity to perform a public service.

A lot of "Old Timers" have turned up in the Novice bands in the last week or so. Looks like they are looking to us "kids" for some practice in CW that they haven't used in ten years or more. I had one ask me to QRS. What a boost for my morale! You see, I've blown the CW test at FCC three times.

> Robert W. Malmquist Morris, Illinois

Dear 73,

As a Canadian studying like mad for my own ham ticket, I feel that our system is still better. It means a lot of hard work before we even get on the air, but the feeling of accomplishment is much greater and it is this, I'm sure, that carries you through to the advanced classification.

With your Novice License so easy, it is not much of an accomplishment to get one, no great feeling of doing something can only lead to boredom with the whole affair. Anticipation is still half the fun of getting anything, so don't rob your youngsters of this personal pride and great feeling.

F. B. Houghton Vancouver, B. C., Canada

Poor Judy!

Dear 73,

Re J. D. Weaver's correction to Judy's antenna p. 109 October issue:

Where may I obtain one of those magical, mystifying, free floating, gravity defying pulleys that J. D. Weaver uses on his antenna? Seems to me that the pulley at the end of the antenna would permanently station itself on the bucket handle which would, I assume, not be the desired effect. Why not tie one end of a safety line to the bucket handle and the other end to a tree limb (using the antenna arrangement as originally shown). If the antenna should break the safety rope would suspend the bucket well

above ground until repairs could be made.

John Stroup K7KBH Cornwallis, Oregon

Dear 73,

Some of the letters which appear in your wonderful magazine can be downright interesting. I have in mind two letters which appear in the Ooctober 1967 issue; one from VK7RG in Australia mentions interest in anti-gravity projects, and the other from W7AAF/W8BGP who appears to have solved the problem of keeping an antenna up in the air with no visible means of support. These two old boys should get together. Take a look at that illustration on page 109 and see that there is nothing in evidence to keep the pulley from sliding down the rope which supports the bucket.

In order to make this set up practical, simply drop another line from a point in the tree 5 or more feet above the pulley and attach it to the pulley.

> George H. Gabus WB2IJF Downsville, New York

I agree that the antenna support certainly appears to be anti-gravity, but if you ran a test with the bucket rope tied of at an angle of about 30° from the vertical as shown in sketch, the antenna will not slip down to the bucket handle. It will stop at the point where it makes a 120° angle from the vertical—it's a simple matter of vectors. If you doubt it, try it!

Bouquets or otherwise

Dear 73.

One of the issues of your journal 73 magazine came to my hand and I was really delighted by its contents. The articles about amateur technique are excelent as well as their illustrations and it is just a pity that your journal is, owing to lack of currency, not distributed in our country.

Zdenek Kvitek Brno, Czechoslovakia

Dear 73

I must congratulate you on the fine series of articles in 73 and the general upgrading of the magazine in the past months. The transistor and solid-state articles have been an eyeopener and speaking for many hams, I must say that you have done hamdom a world of good by opening the world of solid state.

Keep up the lucid series of articles you have been running in the magazine.

> K. Nose KH6IJ Honolulu. Hawaii

Dear 73,

Maybe you will tell me something. Why can't CQ or QST come up with as many good technical articles for the "poor" and "inexperienced" hams as you can? Until they do, I'll be subscribing to 73.

Ray L. Mote, Jr. K5FKT/KP4 APO New York 09845

Dear 73.

I wouldn't have given 2¢ for your magazine until I talked to your rep at the Los Angeles Ambassador Hotel ARRL Convention . . I was given a free September issue and read it. What an improvement! I am now awaiting the next issue.

R. E. Peebles, Jr. WB6VPY Los Angeles, California Dear 73.

After seeing a notice in a rival magazine noting it was the cheapest, I thought someone ought to note that a VW is cheaper than a Rolls-Royce.

> Scott McCann W3MEO Arnold, Maryland

Dear 73.

I refer to your writings in the June and September issues of 73, and in particular to the last paragraph

of the article in the September issue.

From a trend which started in the late '50s, I know that it has grown more in vogue for the staff of amateur radio publications to launch into campaigns advocating the addition of this, or the elimination of that. The pattern is pretty obvious; good technical articles are, and will continue to be, more avidly sought for by the readers than the politics of the ham magazine. It seems that more and more, your readers are being tossed bones of contention rather than gems of wisdom.

I cannot seriously believe you, yourself, are convinced of the total validity of your arguments . . . If your goal has been to create dissention in one of the finest fraternities in the world, you have certainly

> P. A. Rodd K2BVS Bayville, New Jersey

.. I am greatly pleased to see more and more technically oriented articles appearing in your magazine. I hope they will encourage amateurs to do more reading and building.

> Robert L. Magill WA6MUG Garden Grove, California

Dear 73,

I just finished reading your August issue of 73.

Very good.

I just passed my General in July, and as yet haven't received my ticked. After reading all of the letters written in, I was very pleased to see that you have a column in which we may express our feelings. But I hope that we hams don't sit around thinking about which is better; SSB or AM. We should have better things to do than sit around and gripe. Let's get in there on the frequencies and do some good for amateur radio itself.

> Lee Hays WA5PPF Abilene, Texas

Dear 73.

I would like to congratulate you on a presentation of excellent material in your August 1967 issue. I was especially happy to read the articles on transistor oscillators and toroids as I am currently engaged in building a very small FET-ized receiver.

> A. R. Werback China Lake, California

Dear 73.

Well, I never thought you guys would do it. I expected to hear from someone from New Hampshire skipping down to Rio with a hunk of cash. I'm talking about that back issue deal for a dollar a year. The last bundle came today amid quite a few grumbles from Sam, my postman, and his sore back. It's a good thing that all 57 issues didn't come at once. I've been up 'till 1:30 AM each night for the past five days reading the back goodies.

> Tony Russomanno WB2YVU Whippany, New Jersey

We lost money on every bundle, Tony, but we are making it up in volume!

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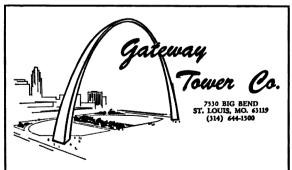
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ALUMINUM TOWERS

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Dear 73.

After having complained about late delivery and poor wrapping of 73, I feel you deserve a good report when you have earned it. The September issue (1967 hi) arrived on August 24th, and the wrapper was so tough it was not even mussed! The circulation department has earned a commendation for their success in remedying the old problem.

Charles M. Cross WB6SWJ Palo Alto, California

Dear 73,

Last night I assembled the globe which came to me as a gift for two year subscription to 73. The assembly of the globe was easy, but what amazed me was that it was lighted and really up-to-date in all details . . . In my estimation, 73 magazine is hard to beat in the amateur radio world, and now your illustrated globe becomes a part of my Collins radio outfit. I hear the world, and now I "see" the world.

Syd Tymeson W3FL Takoma Park, Maryland

Dear 73.

I just finished reading by September issue of 73 Magazine. I found all the articles very good and enjoyed one article, especially, because it couldn't have been more true. It was entitled "How to Be a Ham, By Really Trying". The author points out that most potential hams are too lazy to try to master the code. This is true . . . I went through the same thing when I started out, but once accomplished, it makes you feel good. For once in your life you have really done something. It sure helps if there is a ham in your neighborhood. Most every ham would walk a mile to help another fellow get started. If it wasn't for a local ham, I probably wouldn't be in the position that I am in now. I am grateful now, this hobby is really terrific . . . educationally and socially.

Werner G. Vavken WB6RAW Pacifica, California



Dear 75,

Your article "World's Fair 1939" in the July issue of 73 brought back pleasant memories. Enclosed is my QSL, a duplicate of the one seen in picture on page 33, 5th from the top in the 7th row from the right. It is a little shop worn after 29 years.

I also have a W2USA Radio Operators Card signed by W2KU Oscar Ochmen and Walter Smith Jr. which I received to operate W2USA.

Raymond W. Rock W3EKZ Whitemarsh, Maryland

Dear 73,

How your article, entitled "Torticollis and All that Jazz" will be received by the gentlemen of hamdom is debatable, yet I was thoroughly amused by its delightful similiarity to my own experiences.

As a novice, working only CW, I too find the OMs coming at me left and right, except for those regular friends I've made with repeated contacts... Since I

have recently had that nail-biting experience of passing the general exam, as I await that big ticket. I wonder how closely my newly earned phone privileges will parallel those of Cheryl. I'm not a YL, but an XYL with three children, the youngest being about the age of Cheryl.

One additional frustrating thought to add to those of Cheryl's; when traveling, how nice it would be to stop and say "hi" to one of those particularly interesting contacts you've worked repeatedly, yet still be one of the "fellas on the air" in the eyes of his XYL. Conclusion... stay frustrated... don't!

Thank you for this entertaining article, so paralleling my own and possibly other YL and XYL experiences.

Penny Bonnema WN2ZNN Towaco, New Jersey

Dear 73.

What goes with the YLs? As there are two articles in the same issue by "the weaker? sex". It seems we now have no place to hide from your domination as we have been doing since the beginning of time. Hi. More power to you and let's have more articles.

Sam Moskowitz K3RTR Upper Darby, Pennsylvania

Dear 73,

I thought you might like to know that we radio amateurs are still getting publicity via AM/FM radio. During the Fairbanks, Alaska flood recently, KTNT AM/FM carried taped communications between Dave Moran, a radio amateur who works for KTNT and two KL7 stations in Fairbanks during the two or three days the flood was at its worst. I monitored other stations in the area, but didn't hear radio amateurs mentioned at all.

Ralph Westgrund W7IJJ Tacoma, Washington



Dear 73,

Last week I had the pleasure of having my antenna base installed by WAIDRO. Everything went FB. The best part was when the cement truck came along with the number 73. What luck! I immediately got my camera and snapped this picture. To add to my delight, his name was Jim.

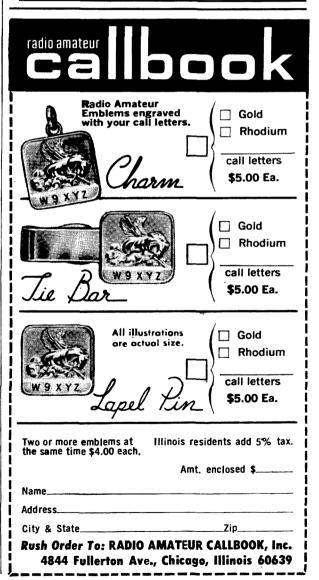
Nat Cohen WN1HBX Milton, Massachusetts

Dear 73.

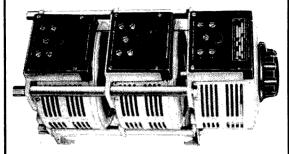
This may be a first, I constructed an FET transmitter. It consisted of a Crystalonics CP651 in a Pierce crystal oscillator and a CP 650 amplifier. I worked WB2JKL on 40 meters, Field Effect transmitter supplied about 1 watt to the antenna. Is this the first FET transmitter contact? The distance was about 180 miles.

Ed Noll W3FQJ Chalfont, Pennsylvania

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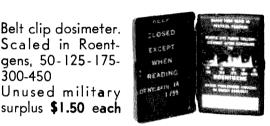


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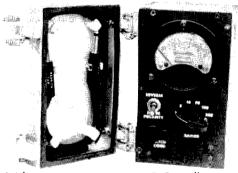


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EASTERN UNITED STATES TO:

GMT:	00	02	94	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	38	14	21	25	21
ARGENTINA	14	14	14	7A	7	7	14A	21	21	26	28	21
AUSTRALIA	21	14	7B	7B	7.03	78	7B	14	21	21	21	21 A
CANAL ZONE	14	7	7	7	7	7	14A	21	25	28	21	21
ENGLAND	7	7	7	7	7	7	14	21A	28	21	14	7
HAWAII	21	14	7	7	7	7	7	7B	14	21A	25	21A
INDIA	7	7	78	7B	78	7B	14	21	14	14	78	-1
JAPAN	14	TA	7B	7B	7	7	7	2	7B	7B	78	14
MEXICO	14	7	7	7	7	7	7	14	21	21A	21	21
PHILIPPINES	14	14	7B	7B	7B	713	7	7A	7B	7B	7B	14
PUERTO RICO	7A	7	7	7	7	7	14	21A	21A	21	21	14
SOUTH AFRICA	14	7A	7A	7B	7B	14	21	28	28	21	21	14
U. S. S. R.	7	7	7	7	7	7	14	21A	14	713	78	7
WEST COAST	21	14	*	7.	7	7	7	14	21	28	28	21

CENTRAL UNITED STATES TO:

ALASKA	21	14	7	7	7	7	7	7	14	21	28	21A
ARGENTINA	14	14	14	14	7	7	14A	21	21	28	28	21
AUSTRALIA	21	14	7B	7B	7B	7B	7B	14	21	21	21	21A
CANAL ZONE	14	7A	7	7	7	7	14	21	28	28	28	21
ENGLAND	7	7	7	7	7	7	14	21	21A	21	14	7
HAWAII	21	14	7	7	7	7	7	7	14	21A	28	28
INDIA	7	7	7B	7B	7B	7B	7B	14	14	тв	7B	7
JAPAN	21	14	7B	7B	7	7	7	7	7	7B	78	14
MEXICO	14	14	7	7	7	7	7	14	14	31	21	14
PHILIPPINES	14A	14	78	78	TB	7B	7	7	7A	7A	7B	14
PUERTO RICO	14	7	7	7	7	7	14	21	21A	21	21	21
SOUTH AFRICA	14	7	7	7В	7B	78	14A	21A	21A	21	21	21
U. S. S. R.	7	7	7	7	7	7	7B	14A	14	7B	78	7B

WESTERN UNITED STAMES TO:

ALASKA	21	14	7	ī	7	7	7	"	1	14A	21A	28
ARGENTINA	21	14	14	1	7	7	14	21	21	25	28	28
AUSTRALIA	28	25	14A	14	14	7B	7B	7B	14	21	21	21
CANAL ZONE	21	14	TA	7	7	å.	7	14A	26	25	28	28
ENGLAND	78	7	7	7	7	**	733	733	14A	14	14	7.8
HAWAII	24	21	14	14	#	7	1-	+-	14	21A	28	28
INDIA	7.A	14	7A	7B	7B	* 7B	7B	7	7	7B	713	7B
JAPAN	21A	21	14	78	7	7	7-	7	7	7 B	7B	14A
MEXICO	14	7A	3.0	7	7	7	7	7	14	21	21	21
PHILIPPINES	21A	21	14	7B	7В	7	7	7	7.4	7A	78	14A
PUERTO RICO	14	14	1	7	7	7	7A	144	21A	28	28	21
SOUTH AFRICA	14A	14	TB	7B	78	7B	7B	14	21A	21A	21	21
U. S. S. R.	7B	7	7	7	7	7	7B	7B	14	7B	78	7В
EAST COAST	21	14	7	7	7	7	7	14	21	28	28	21

- A. Next higher frequency may be useful this hour.
- B. Very difficult circuit this hour.

Good: 1-3, 5-12, 15-17, 20-24, 26, 27 Fair: 4, 13, 14, 18, 19, 25, 28, 31

Poor: 29, 30 VHF: 4, 21



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WANTED: January 61 issue of 73 Magazine, desparately needed to complete set. Also need QST March 61 and July 60, and CQ July 1965. Box 1167B, 73 Mag., Peterborough, N.H. 03458.

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WANT TO CORRESPOND with Hams and SWLs in USA and other parts of the world. Would also like to receive club magazines from radio clubs. K. Harvant Singh, 31, (774), Upper Museum Rd., Taiping Perak, West Malaysia, Malaysia.

1963 BOUND VOLUMES OF 73. \$10 each from 73, Peterborough, N. H. 03458.

MILITARY SURPLUS TV EQUIPMENT, by Roy Pafenberg, giving schematics of CRV-59AAE TV Camera, CRV-59AAG high sensitivity camera, CRV-52ABW TV transmitter, CRV-60ABK TV monitor unit, and CRV-46ACD TV receiver, all for \$1.00 from 73 Magazine, Peterborough, N.H. 03458.

WANTED: All types of aircraft, ground radios and tubes, 4CX1000A's, 4CX5000A's, 304TL's, etc. 17L7, 51X, 618S, 618T, R388, R390A, GRC units. All 51 series. All Collins ham or commercial items. Any tube or test equipment, regardless. For fair, fair action. Ted Dames Co., W4KUW, 308 Hickory St., Arlington, N.J. 07032.

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WANTED: January and March, 1961, issues of 73 Magazine for my personal collection. S. B. Young, WØCO, Rural Route 3, Box 94, Wayzata, Minnesota 55391.

WANTED: Tubes, transistors, lab instruments, test equipment, panel meters, military and commercial communication equipment and parts. Bernard Goldstein, Box 257 Canal Station, New York, N.Y. 10013.

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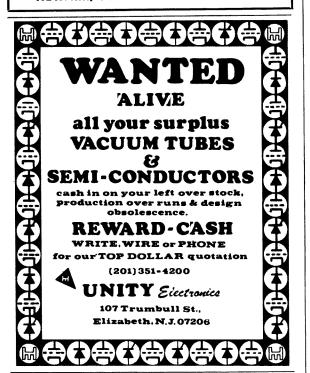
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TRADE HEATH GP-11, 12V mobile power supply, for 6V supply. Tim Watkins, WN6WQA, 4838 Reynolds Dr., Torrance, California 90505.

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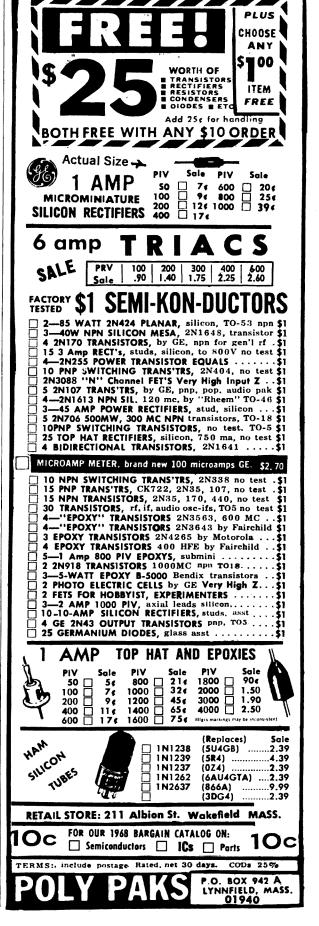
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ARIZONA REPEATER ASSOCIATION, a new club, has been formed. Meetings will be the 4th Mondays at the First Federal Savings & Loan Bldg., 20th St. & Camelback, Phoenix, at 7:30 P.M. Repeater frequencies will be 146.34 input and 146.94 output. Joel Kaplan, WA7ERH, is Secretary.

WANTED BACK ISSUES of 73 Magazine. October 1960; January, February and March of 1961, and June of 1962. Joe Furiak, VE7BAD, 1311 Second Trail, British Columbia, Canada.

MECHANICAL DEVICES "Great Buys" catalog, 10¢. IF assembly 30 MHz loaded with miniature components, cost government hundreds, \$5.95. Transistorized computer boards, assortment totalling 75 transistors or more, \$5.95. Teletype model 14 typing reperforator with automatic tape take-up rewinder electric driven 115VAC 60 cy SP, both units new unused, \$69.95. Bonanza specials, \$2 each (generous quantity) gears, knobs, relays, toroids, switches: rotary, toggle, lever. Satisfaction guaranteed. More information on request. Fertik's Electronics, 5249 "D" Street, Philadelphia, Penna. 19120.

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